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Environmental Assessment

Spirit Lake Motorized Access for Core Sampling and Inlet Access

Gifford Pinchot National Forest
Mount St. Helens National Volcanic Monument
Skamania County, Washington

Legal Land Description: T9N, R5E, Sections 8, 9, 15, 16, 22, 23, 26, 27
Willamette Meridian

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INTRODUCTION

The Monument Manager of the Mount St. Helens National Volcanic Monument is analyzing a proposal to provide motorized, administrative access to the south shoreline of Spirit Lake for operations, maintenance and repair of the tunnel intake structure, and to provide access for tracked drilling rigs to collect borehole data to support information for safe lake elevation levels.

The goal of the project is to provide safe and cost effective access for operation and maintenance of the Spirit Lake outflow and to contribute to the safety of maintenance personnel and downstream communities.

The project location is north of Mount. St. Helens, just south of Spirit Lake in the legislated Mount St. Helens National Volcanic Monument. The legal land description: T9N, R5E, Sections 8, 9, 15, 16, 22, 23, Willamette Meridian.

A rockslide-debris avalanche during the 1980 eruption of Mount St. Helens blocked the natural outlet of Spirit Lake to the North Fork of the Toutle River. The lake level must be controlled to prevent the water from over-topping the outlet and potentially causing large-scale mudflow down the Toutle River Valley. In 1985 the U.S. Army Corps of Engineers constructed a 1.6 mile, 11-foot diameter tunnel bored horizontally through rock under Harry's Ridge on the Mount St. Helens National Volcanic Monument (Monument) to systematically release water and maintain a safe water level in Spirit Lake.

As the tunnel has aged, it has experienced periodic fracturing of its lining and uplifting of the tunnel floor. The Monument has prepared a Spirit Lake Emergency Response Plan in the event of future tunnel blockages, volcanic eruptions, seismic events or other environmental conditions that could significantly affect Spirit Lake water levels. Short-term critical repairs to partial blockage of a 30-foot section of tunnel were completed during winter 2016. Over the next several months, long-term options are being considered to identify a sustainable solution to the outlet. This proposal addresses one piece of that long-term solution by providing motorized administrative access to the southwest lakeshore area. This access is needed to support maintenance of the tunnel inlet structure, log debris boom, and other constructed improvements that support the tunnel outflow and maintenance of safe elevation levels of Spirit Lake.

Access issues encountered as part of maintenance activities over the past year have highlighted a need for alternatives to helicopter access to the tunnel inlet. The availability of motorized administrative access is especially important to provide for the safety of emergency response personnel who are attempting to conduct repairs and restore lake outflow during unfavorable weather when aerial access is restricted. Operations and maintenance activities at the tunnel inlet structure can be limited and delayed by helicopter and aviation management personnel.

Additionally, motorized administrative access will provide tracked access for core-sample drilling which is intended to aid in the determination of the geologic structure of debris blockage and its potential suitability as a location for an alternative outflow for Spirit Lake. The core samples will also inform the Spirit Lake Emergency Response Plan related to the composition of the debris blockage, location of groundwater, and their potential influence on blockage stability.

As part of ongoing annual inspection efforts, administrative access will facilitate reading groundwater monitoring equipment.

The Monument completed planning for drilling the test holes earlier this year. Originally, the drilling equipment was to be transported using helicopters and no motorized ground access was thought to be needed. Ideally, drilling equipment would be transported by helicopter, if it is affordable. The first attempt to contract out the drilling was found to be cost-prohibitive. If further attempts determine that this option is not feasible, ground access would be used.

NEED FOR THE PROPOSAL

The purpose of this project is to facilitate Forest Service personnel's ability to conduct operation, maintenance and repair activities at the Spirit Lake project (tunnel inlet structure, debris blockage area) with reduced risk to personnel, and increased ability for site access.

The needs for the proposal include:

- Data gathering on the geotechnical components of the debris field through core sampling for subsurface investigation in the SW corner of Spirit Lake in order to better understand the geologic structure of the debris blockage and what might happen if the blockage began to breach and/or its potential suitability as a location for an alternative outflow for Spirit Lake.
- Motorized access for drilling equipment to reach the debris field.
- Safety of emergency response personnel who are attempting to conduct repairs and restore lake outflow during unfavorable weather when aerial access is restricted.
- Long-term, motorized access for operation and maintenance of the Spirit Lake Tunnel.

Desired Condition

There is a desire to have more knowledge around the geological make-up of the rockslide-debris avalanche and to increase the agencies' understanding of risk associated with the natural debris blockage and associated lake water elevation levels.

There is also a desire to have a permanent, motorized access path that could support the efficient travel of employees, contractors and equipment for maintenance of the tunnel inlet structure, log debris boom and barrier intake system, annual inspections, and other constructed improvements that support the tunnel outflow and maintenance of safe elevation levels of Spirit Lake.

Motorized access would be for administrative, authorized utility terrain vehicles (UTVs) necessary for improved access to address ongoing operations and maintenance activities. Utilization of this type of UTV would require an administrative workboat to access the Spirit Lake tunnel intake area.

Administrative ground access via UTV and workboat during the field season to inspect the tunnel and debris blockage, open and close the slide gate, and perform scheduled operation and maintenance will allow for reduced risks and costs associated with the current access alternative

and increase the Forest Service's ability to access the intake structure. Administrative access with UTV would typically occur during May through October approximately ten or fewer times a season, unless repairs are being conducted at which more frequent access would be necessary.

Existing Condition

A rockslide debris avalanche during the 1980 eruption of Mount St. Helens blocked the natural outlet to Spirit Lake to the North Fork of the Toutle River. The lake level must be controlled to prevent the water from over-topping the outlet and potentially causing large-scale mudflow down the Toutle River Valley. In 1985 the U.S. Army Corps of Engineers constructed a 1.6 mile, 11-foot diameter tunnel bored horizontally through rock under Harry's Ridge on the Mount St. Helens National Volcanic Monument (Monument) to systematically release water and maintain a safe water level in Spirit Lake.

Since the Spirit Lake Outlet Tunnel was constructed by the U.S. Army Corps of Engineers in 1985, the U.S. Forest Service has had the financial and management responsibilities for the operations, maintenance and repairs. In the thirty-two year history of the tunnel, more than $11 million has been spent to inspect, repair and prepare risk assessment studies related to Spirit Lake outflow and the debris blockage.

As the tunnel has aged, it has experienced periodic fracturing of its lining and uplifting of the tunnel floor. The Monument has prepared a Spirit Lake Emergency Response Plan in the event of future tunnel blockages, volcanic eruptions, seismic events or other environmental conditions that could significantly affect Spirit Lake water levels. Short-term critical repairs to partial blockage of a 30-foot section of tunnel were completed during winter 2016. Log debris removal and efforts to restrict debris from floating in to the tunnel inlet occurred in 2016 and will continue in 2017. The log debris effort will require regular maintenance at the tunnel inlet. Annual and 5-year periodic inspections identify maintenance and repair tasks that include repairs to the tunnel and intake to improve the integrity of the structure and to address safety and health improvements for operations and maintenance personnel.

As part of an approach to identify a sustainable, safe and resilient Spirit Lake outflow, the National Academies of Sciences, Engineering, and Medicine chartered a scientific committee which is preparing an assessment to consider the adequacy of existing information and risk analyses for the area; identify possible options for long-term management of Spirit Lake water level and sediment transport in the North Fork Toutle River drainage; and suggest additional information needed to support these options. The goal is to provide for the safety of the downstream public and the employees that maintain the volcanic sediment infrastructure, and to contribute to ecological restoration in a manner that accounts for the dynamic ecological and geologic landscape. As part of this effort, it is expected that additional activities to identify and study the geologic, seismic, hydrologic and volcanic environment will be required to best determine a long-term outflow.

Figure 1. Log debris reduction efforts at Spirit Lake tunnel intake.

Figure 2. Inspection at Spirit Lake tunnel outflow.

Figure 3. Spirit Lake tunnel.

Access for Drilling Equipment

Drilling core samples of the debris blockage on the southwest corner of Spirit Lake is essential to understand the geotechnical components of the debris field. The drilling would fill in the data gaps from drilling that occurred in the 1980s by the U.S. Army Corps of Engineers.

In 2016, two reports were completed to better understand risks associated with Spirit Lake outflow. One report entitled, "Spirit Lake Outlet Project Semi-Quantitative Risk Assessment for Existing Project and Alternatives" was led by the U.S. Army Corps of Engineers with team participation by the U.S. Forest Service, Bureau of Reclamation and U.S. Geological Survey. The Risk Assessment's purpose was to provide relative risk information for the existing outlet and tunnel and four alternatives to assist USFS in the decision making process.

Recommendations from the Risk Assessment support drilling activities to increase understanding of the debris blockage. One recommendation was to confirm the critical contact elevation

between the ash-cloud and debris avalanche deposits. Another recommendation was to verify the groundwater regime by reestablishing a piezometer reading schedule and data evaluation. Understanding groundwater movement and elevation levels along with verifying contact elevation between ash-cloud and debris avalanche deposits will facilitate reevaluation of safe lake elevation levels which is another recommendation from the Risk Assessment.

The second report completed in 2016 related to Spirit Lake outflow management is a Pacific Northwest Research Station Technical Report, *The Geologic, Geomorphic, and Hydrologic Context Underlying Options for the Long-term Management of the Spirit Lake Outlet Near Mount St. Helens, Washington* (Grant, et al). The purpose and scope of the report is delineated in its Executive Summary:

> *This report is in direct response to the Congressional charge. It is also part of a broader review of hazard mitigation in the Toutle River watershed, a review that also includes an analysis by the National Academies of Sciences, Engineering, and Medicine (see: http://www8.nationalacademies.org/cp/projectview.aspx?key=49785). The specific objectives of our analysis are:*
>
> - *Evaluate the potential for tunnel failure and consequent catastrophic dam breach posed by the current conditions and configuration of both the tunnel and the debris blockage;*
> - *Evaluate potential consequences to downstream communities and infrastructure in the event of a catastrophic breaching of the blockage;*
> - *Evaluate potential risks associated with alternative lake outlets;*
> - *Identify any data or knowledge gaps that would need to be addressed in order to fully evaluate management options* (Grant et al, page 7).

Of the seven recommendations in the Technical Report, one specifically identifies drilling within the debris blockage area.

Better understanding of the character and physical properties of the blockage at depth.

> *The debris blockage was drilled in the early 1980s as part of the characterization of the stratigraphy and material properties of the blockage (Glicken et al., 1989). Coupled with geophysical surveys noted above, additional drilling to provide a more complete 3D picture of the character of the blockage at depth would help better understand what might happen if the blockage began to breach. Specifically, are there regions within the blockage where the size of sub-surface material in the debris-avalanche deposit might be expected to resist vertical incision if a breakout were to occur. This information would be particularly useful to guide siting and design of an open channel.* (Grant et al, page 111).

Both reports identified gaps in geologic composition knowledge of the Spirit Lake debris blockage. To aid in the reduction of uncertainties in the geologic model, the Forest Service will be working with other organizations to use geophysical equipment for subsurface investigations in addition to drilling and coring. These methods will be used to increase the understanding of the geologic and groundwater characteristics of the debris blockage area.

This project would support the exploration of long-term, sustainable Spirit Lake outflow options that align with the dynamic geologic and ecological landscape. Drilling core samples of the debris blockage on the southwest corner of Spirit Lake is essential to understand the geotechnical components of the debris field. The drilling will fill in the data gaps from drilling that occurred

in the 1980s by the U.S. Army Corps of Engineers. The core samples will also inform the Spirit Lake Emergency Response Plan related to the composition of the debris blockage, location of groundwater, and their potential influence on blockage stability. The Monument completed planning for drilling the test holes earlier this year. Originally, the drilling equipment was to be transported using helicopters and no vehicular ground access was thought to be needed. However access limitations, safety concerns related to future maintenance, and further feasibility assessments have found that this option was not practical and a motorized ground access route was necessary.

Existing Access to Tunnel for Maintenance

Since tunnel construction in 1985, the primary access method for tunnel intake operations and maintenance activities is via helicopter using the landing area located immediately south of the tunnel intake. The debris dam and tunnel intake structure are located on the western shore of Spirit Lake which is on the east-facing slope of Harry's Ridge. There is no road access to the tunnel inlet; access is by helicopter and boat or by foot over Harry's Ridge.

All modes of transportation require rigorous mission and safety planning, and have an inherent risk associated with the activity. Current access is proving to be inadequate and dangerous because:

- **Weather** – Helicopter operations to the tunnel intake require that wind direction and speed, ceiling and visibility be adequate to ensure safe operations. Weather conditions at Mount St. Helens vicinity can lead to flight cancellations throughout all seasons.
- **Availability** (equipment and personnel) – During the field season, helicopter availability is limited. The wildland fire season during this same time of year can limit the availability of helicopters and helicopter personnel required to manage a Spirit Lake mission. The U.S. Forest Service aviation personnel are primarily tasked with wildland fire and all risk missions. In nearly all cases those primary tasks would take precedent over project missions such as Spirit Lake tunnel.
- **Danger/risk**- Helicopter access requires risk management planning to prepare for missions to the tunnel intake. All other access to the tunnel intake requires back country travel including limited access roads, overland hiking and working in areas with the potential for falling rocks and changing conditions. In the event of an injury, transport is limited by access conditions. Access by foot over Harry's Ridge is steep, arduous and generally inaccessible. Forest Service climbing rangers accessed the intake via this route and identified this method as only available for individuals skilled in climbing and rope use and while carrying minimal additional tools.

When the tunnel gate is closed, access to the intake structure is possible from the downstream end by foot under the requirements of a Confined Space Permit. The tunnel outlet structure can be accessed by foot, whereas access for small vehicle equipment requires the use of a temporary bridge over South Coldwater Creek. This access is can only be used once the tunnel slide gate is closed, stopping water flow. Forest Service staff must already have accessed the tunnel intake via other methods to stop water flow.

Figure 4 and Figure 5. Photos of helicopter landing for Spirit Lake tunnel intake.

Management Direction

This EA tiers to the 1985 Final Environmental Impact Statement for the Mount St. Helens National Volcanic Monument's Comprehensive Management Plan (CMP) and the 1990 Final Environmental Impact Statement that informed the *Gifford Pinchot National Forest Land and Resource Management Plan* (Forest Plan, 1990). Guidance on management of the legislated Monument comes from the Mount St. Helens National Volcanic Monument's CMP. Additional management direction comes from the Forest Plan, as amended by the *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl* (Northwest Forest Plan, 1994).

Mount St. Helens National Volcanic Monument

Any new proposals within the Monument are carefully evaluated in view of the legislative mandate for the Congressionally-designated monument to provide for public safety, recreation, and the preservation of unique features and opportunities for research. The 110,000-acre National Volcanic Monument was established in 1982 to preserve one of the world's youngest and most geologically active landscapes (Public Law 97-243). Since its eruption in 1980, Mount St. Helens has become a world-renowned laboratory for geological and biological research.

The 1982 Act establishing the Monument and 1985 Comprehensive Management Plan (CMP) recognize the importance of permitting measures within the Monument to ensure public safety. Specifically, the legislation states that nothing in the act "shall prohibit the Secretary from undertaking or permitting those measures within the Monument reasonably necessary to ensure public safety and prevent loss of life and property" and that the "Secretary shall permit the full use of the Monument for scientific study and research, except that the Secretary may impose such restrictions as may be necessary to protect public health and safety and to prevent undue modification of the natural conditions of the Monument" (Public Law 97-243, Section 4(b)(3) and 4(c).

The CMP specifically recognizes the importance of providing access for repair and maintenance of the Spirit Lake outflow to provide for the safety of downstream communities. The CMP states, 'The construction of the tunnel was completed prior to the implementation of this Forest Service Comprehensive Management Plan and will impact lands within the monument. The need to accommodate an outlet to Spirit Lake was taken into account throughout the alternative development and evaluation process of this plan (Monument CMP 1985, Page 3)".

It is also important to note that the area involving the proposed action is located within the most scientifically important and sensitive area in the monument and is designated a Class I Research Area by the CMP. The area which was most heavily impacted by the 1980 eruption is the site of numerous long-term studies of ecosystem response to large-scale disturbance.

A key part of the proposed action is that motorized access to the south shore of Spirit Lake will be managed in a way that minimizes its effects and associated impacts resulting from changes in patterns of public use and recreation. Efforts to maintain consistency with the enabling legislation and CMP preservation objectives are included in the effects section.

This EA is the latest in a series of management actions undertaken by the Gifford Pinchot National Forest to provide for the protection of downstream communities while working to balance the need to continue to reasonably provide for CMP preservation objectives.

In 1985, under Presidential Emergency Declaration, federal management actions involved the construction of a primitive road across the Pumice Plain to facilitate construction and operation of an emergency pumping station. The pumping station was operated to control the level of Spirit Lake until the tunnel could be constructed and stable lake outflow restored.

In July 1989, management actions were undertaken to respond to requests from the scientific community to preserve motorized access to the Pumice Plain. Access was deemed necessary to facilitate transport of personnel and materials and minimize the need for costly helicopter support. This resulted in preparation of an Environmental Assessment for maintenance of the 99 Road Extension beyond Windy Ridge. The project also included the establishment of a designated parking area for scientists and placement of large boulders to prevent motorized vehicles from traveling further out onto the Pumice Plain. The 99 Road Extension continues to be used primarily as a public hiking trail and for permitted motorized access by scientists, educators and emergency responders engaged in search and rescue and medical transport.

All of the Mount St. Helens National Volcanic Monument falls within "Category A" in the Forest Plan. The goal of this management area category is to "protect the geologic, ecologic, and cultural resources, allowing geologic forces and ecological succession to continue substantially unimpeded. Permit scientific study, research, recreation, and interpretation, consistent with the provisions of the Act" (Forest Plan, IV-113).

Forest Plan standards and guidelines provide direction on providing, maintaining, and protecting recreation infrastructure and experience during management activities according to how the land is allocated. Forest plans also define the Recreation Opportunity Spectrum and Visual Quality Objectives for areas.

The Recreation Opportunity Spectrum is a method for classifying types of recreation experiences available, or for specifying recreation experience objectives desired in certain areas. The Recreation Opportunity Spectrum has been divided into six major classes for Forest Service use: Urban, Rural, Roaded Natural, Semi-Primitive Non-Motorized, Semi-primitive Motorized, and Primitive. The project area and surrounding environment is classified primarily as *Semi-Primitive Non-motorized* with smaller areas of *Roaded Natural* near Windy Ridge and Johnston Ridge Observatory. Semi-Primitive Non-motorized is "characterized by a predominantly natural or natural-appearing environment of moderate to large size. Interaction between users is low, but there is often evidence of other users. The area is managed in such a way that minimum on site controls and restrictions may be present, but would be subtle. Motorized recreation use is not permitted, but local roads used for other resource management activities may be present on a limited basis. Use of such roads is restricted to minimize impacts on recreational experience opportunities" (Forest Plan, GL-18).

Roaded natural is "characterized by a predominately natural-appearing environment with moderate evidence of the sights and sounds of humans. Such evidence usually harmonizes with the natural environment. Interaction among users may be moderate to high, with evidence of other users prevalent. Resource modification and utilization practices are evident, but harmonize with the natural environment. Conventional motorized use is allowed and incorporated into construction standards and design of facilities" (Forest Plan, GL-18).

Visual Quality Objectives are categories of acceptable landscape alteration measured in degrees of deviation from the natural-appearing landscape. The Objectives has been divided into six major classes for Forest Service use: Preservation, Retention, Partial Retention, Modification, Maximum Modification, and Enhancement. The project area and surrounding environment has been classified as *Retention* under the Visual Quality Objectives, which "provides for management activities that are not visually evident. Under Retention, activities may only repeat form, line, color and texture that are frequently found in the characteristic landscape. Changes in qualities of size, amount, intensity, direction, pattern, etc., should not be evident" (USDA FS, 1974). Most of the activity proposed falls within the middle ground (0.5-3.0 miles) distance zone and the scenery has a high sensitivity level and distinct class.

Other Management Direction

The project is consistent with FSM 7700 (chapter 7710) in relation to road management. No new roads would be constructed or decommissioned. The proposed motorized trail does not meet the definition of a classified road.

The project area includes several streams. In the Northwest Forest Plan, portions of a watershed directly coupled to streams and rivers are known as riparian reserves. Riparian reserves were established in the Northwest Forest Plan to protect and highlight the importance of riparian areas as one of four components comprising the Aquatic Conservation Strategy (ACS). The main purpose of the riparian reserves is to protect the health of the aquatic system and its dependent species; the reserves also provide incidental benefits to upland species. The reserves help maintain and restore riparian structures and functions, benefit fish and riparian-dependent non-fish species, enhance habitat conservation for organisms dependent on the transition zone

between upslope and riparian areas, improve travel and dispersal corridors for terrestrial animals and plants, and provide for greater connectivity of late-successional forest habitat (NWFP ROD, p. 7).

Decision Framework

The Monument Manager will review the proposed action and alternatives to determine which course of action best meets the objectives for access at Spirit Lake.

The final decision would be to either:

- Select the proposed action or portions of the proposed action for implementation,
- Select an alternative to the proposed action,
- Defer action at this time, or
- Conclude that significant impacts would result from the proposed action which would warrant the preparation of an environmental impact statement.

Public Involvement and Tribal Consultation

Forest and Monument staff held a prescoping meeting with researchers who have active, ongoing research on the Pumice Plain on February 27, 2017. The intent of the meeting was to discuss the initial proposal and solicit feedback from those with intimate knowledge of the area. In addition, former Monument Scientist, Peter Frenzen discussed the project proposal by phone with those that had early involvement with the creation of the Monument including Darcy Mitchem, Susan Saul, Charles Raines from the Sierra Club, Cascade Forest Conservancy, Gregg Drew, and Mark Smith.

On March 15, 2017, a description of the proposal was sent to the Gifford Pinchot National Forest's public mailing list, which includes over 100 individuals, organizations, agencies, and Indian tribes, for comment during scoping. It was also sent to researchers, local governments and local citizens near Mount St. Helens who aren't typically involved with Forest Service projects, but may have a particular interest in work on the Pumice Plain or Mount St. Helens in general. During the initial public scoping period, the Forest Service received 20 letters or emails in response to the proposed action, some with clarifying questions and others offering support or criticism for the proposal. Using these comments, as well as internal input, the interdisciplinary team refined the proposed action that would be addressed in this analysis. Appendix A details the comments received and how they were addressed in this analysis.

In addition, the Forest began coordination early with the Yakama Nation and Cowlitz Indian Tribe. Mount St. Helens above 4,800' is a Traditional Cultural Property.

The Monument Manager sent the draft Environmental Assessment for a 30-day comment period on September 29, 2017. A total of 26 comments were received. All comments and Forest Service response are included in Appendix B.

Key Issues

Key issues were developed through public as well as internal scoping. Issues raised were either used to refine the proposed action through the incorporation of specific design features, or to develop alternatives to the proposed action. Appendix A details the evaluation of scoping comments. The following issues were identified:

Disturbance to Existing Research
Ground disturbance associated with the proposed action could directly harm research plots from increased sedimentation, compaction or alteration of stream flow on or near the plots. Other indirect effects could also occur such as noise and dust associated with the use of motorized equipment and alteration of recreational use in the area.

- Alternative 1 was developed to respond to this issue. The alternative would not authorize a path through the Pumice Plain where most of the research is located, but instead reach Spirit Lake from Johnston's Ridge.
- Alternative 2 added after the comment period was developed to respond to this issue. The alternative would use a route down to Duck Bay as a first option and avoid all but one research site.
- Mitigation is included requiring coordination with the Pacific Northwest Research Station and other prominent researchers using the Pumice Plain.
- Effects from ground disturbing activities are disclosed in the effects section.

Hydrologic Issues of Concern
Water quality in streams flowing across the Pumice Plain and in Spirit Lake may be affected by drilling operations and by construction and use of the access route. The proposed activities could affect water quality in streams draining to Spirit Lake by a number of pathways: 1) Drilling may cause direct and indirect impacts to surface and groundwater quality; 2) Construction of the access route may cause sediment delivery to streams and other aquatic features; 3) Re-establishment and compaction of the access route may reduce water infiltration along the length of the access route, and may expose and alter slope angles near streams, increasing overland flow and facilitating surface erosion and increased delivery of fine-grained sediment to streams; 4) Use of the access route by heavy equipment and smaller ATV/UTVs during and after drilling operations may accelerate surface erosion5) Chemical contamination may occur from leakage or failure of equipment and vehicles operated directly in or adjacent to streams crossed by the proposed access route. In addition, stream development processes may be affected by placement of access routes along stream alignments leading to Spirit Lake.

- Alternative 1 was developed partially to respond to this issue. The alternative would not include as many stream crossings.
- Mitigation is included to reduce impacts to water quality.
- Effects from ground disturbing activities are disclosed in the effects section.

Introduction and/or Spread of Invasive Plants
Wheeled or tracked equipment has the potential to be a vector of introduced noxious weeds and invasive species both from materials transported to the Pumice Plain from off-site and from the

transport and redistribution of materials picked up on the Pumice Plain. Noxious weeds often thrive in early seral habitats, with life history traits that aid in rapid colonization of disturbed areas and available habitat niches. Invasive species, whether they are artificially introduced to a disturbed area or not, can play an influential role in early stage succession (Dale & Adams 2003). The addition of a motorized trail into early seral habitat like the Pumice Plain poses a risk to the current succession trajectory if proper design features are not conducted.

- Design features and prevention measures are included to reduce the risk of invasive plant [and animal] introduction and spread.
- A risk assessment is included in the effects section of the EA.

Federal and State Regulatory Consultation

The Washington State Department of Ecology (ECY) is responsible for enforcing the Clean Water Act (CWA) of 1972. The Forest Service is the Designated Management Agency for meeting CWA requirements on National Forest System lands. A Memorandum of Agreement (MOA) prepared and agreed to by the Forest Service and ECY represents the Forest Service Water Quality Management Plan for Washington State. A list of Best Management Practices agreed to by the Monument Manager are included in the Design Features and Best Management Practices section of this EA. Details on impacts to water quality are in the hydrology section.

The United States Department of Interior, Fish and Wildlife Service (USFWS) is responsible for protection and recovery of terrestrial species and non-anadromous fish species that are threatened and endangered under the Endangered Species Act (ESA). Under Section 7 of the Act, the Forest Service is required to consult with the USFWS any time a project may have an effect on a species listed under the ESA. For this project it was determined that project activities would have no effect to non-anadromous bull trout so no consultation with the USFWS for fish species is required.

The United States Department of Commerce, National Marine Fisheries Service (NMFS) is responsible for the protection and recovery of Threatened and Endangered anadromous fish species. For this project it was determined that project activities would have no effect to any federally-listed anadromous fish so no consultation with the NMFS is required.

All steps in the cultural resource process are coordinated with the Washington State Historic Preservation Office (SHPO). A determination was made that “No Historic Properties Affected” (36 CFR 800.4 (d)(1)) and therefore no consultation with the SHPO are required. Cultural Resource Site Reports are filed with and approved by the Washington State Historic Preservation Officer.

PROPOSED ACTION AND ALTERNATIVES

This section describes and compares the alternatives considered for the proposal. It includes a description of the proposed action and alternatives considered.

Table 1. Comparison of General Activities by Alternative.

Proposed Activity	**No Action**	**Proposed Action**	**Alternative 1**	**Alternative 2**
Construction and Use of UTV Access Route for Long-Term Maintenance	No route proposed (0 miles)	New route heading from Willow Springs down the creek to Spirit Lake (1.0 mile)	No feasible route to Spirit Lake by UTV while avoiding effects to research	*Option 1* New route along Forsyth Creek to Spirit Lake (1.9 mile) *Option 2* New route along Forsyth Creek to Spirit Lake (1.9 mile), and (if this route cannot be sustained): new route along Willow Springs Creek (1.0 mile)
Access Route to Drilling Location	No route needed (0 miles)	Construction, reconstruction and use of route across the Pumice Plain from FSR 99 Extension to access drill site, along a pre-existing road alignment that has existed for decades (2.75 miles). Route would be in place for 1-2 seasons.	New route down an existing trail from JRO to the Pumice Plain to access the drill site (3.0 miles). Route would be in place for 1-2 seasons.	*Option 1* Use a helicopter to fly-in drill equipment to project area, negating the need for a motorized route *Option 2* (If drilling equipment cannot be flown in via helicopter), construction, reconstruction and use of route across the Pumice Plain from FSR 99 Extension to access drill site, along a pre-existing road alignment that has existed for decades (2.75 miles). Route would be in place for 1-2 seasons.
Drilling Sites	No drilling (0 sites)	Up to 25 boreholes	Up to 25 boreholes	Up to 25 boreholes

No Action

A description of a *no action* is required under the National Environmental Policy Act, (CFR 1502.14 (d)) and provides a baseline to evaluate any action alternatives. Under a scenario of *no action*, the Monument Manager would not authorize the construction of a motorized trail to the south shore of Spirit Lake. No drilling for core samples would occur or drill equipment would be flown in under the previous NEPA decision. No UTVs would access Spirit Lake for future operations and maintenance. The remnants of the 1980s route now occupied by the Truman Trail (Trail #207) would remain on the landscape.

Proposed Action

The Monument is proposing to reclaim a road bed used for access to Spirit Lake in the 1980s to a width of eight feet from the terminus of Forest Road 99 extension and continue on down Willow Springs to the south shore of Spirit Lake for limited administrative use. The administrative-use-only access will have two uses. One objective is to facilitate ongoing seasonal operations (May through October depending on snowmelt and primary road conditions) and maintenance at the tunnel intake structure by Forest Service maintenance staff via utility terrain vehicle (UTV) and small boat. The second objective is one or two season access for geotechnical drilling. The drilling will be a series of test holes to remove cores samples for further study. Implementation of this project would include the use of core-drilling equipment to obtain samples along the northern part of the Pumice Plain, the six-square-mile area buried in ash following the 1980 eruption. Core samples would be collected at up to 25 site locations. The majority would be drilled to 100 feet or less; 5 sites may be drilled deeper in order to understand contact between landslide debris and original material.

Access for Drilling Equipment

The Forest Service in coordination with the U.S. Army Corps of Engineers conducts annual tunnel inspections, and comprehensive periodic (every 5 years) inspections to determine tunnel integrity and to identify repairs. The inspections in addition to an interagency risk assessment have identified maintenance and repairs that will be addressed each field season over the next several years. Additionally, some of the system repairs and upgrades require annual maintenance to maintain their effectiveness. For these reasons, the USFS and administrative entities require recurring access to Spirit Lake and the tunnel inlet during the late spring, summer and early fall field season.

To facilitate access, a two and ¾ -mile stretch of an old access route would be improved and a trail constructed to be used by all-terrain vehicles to cross the section of Pumice Plain between the researcher's parking lot and the southwest shore of Spirit Lake. Once improved and constructed, the motorized administrative access route would be used for one or two field seasons by tracked drilling equipment to retrieve core samples and for recurring maintenance and repair activities at the Spirit Lake tunnel intake structure.

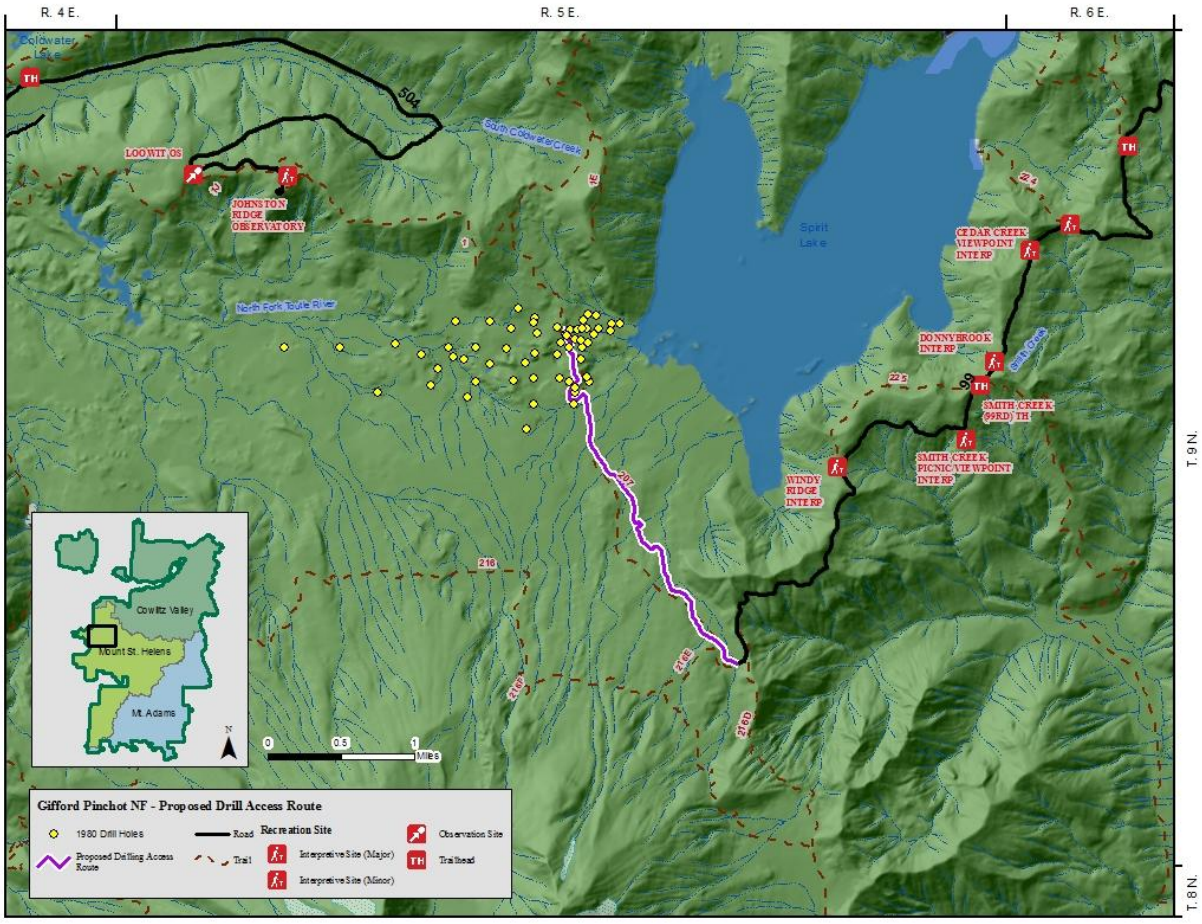


Figure 6. Proposed Action Drilling Route and Previous Drilling Locations from the 1980s.

The access route would follow an old road bed that was the location of the post-1980 eruption emergency pumping operation used to stabilize lake levels until the Spirit Lake Tunnel was completed. During the pumping operation, the U.S. Army Corps of Engineers utilized an administrative access road across the Pumice Plain to the southwest shore of Spirit Lake via an extension of Forest Road 99 beyond the Windy Ridge Viewpoint Parking Lot. Currently, the 99 Road Extension (as the road is commonly referred to) is gated and utilized by the Monument as a segment of the Truman Trail #207 recreational hiking trail, by Emergency Medical Services (EMS) and law enforcement for patient transport and search and rescue, and by researchers to access a small parking lot on the east edge of the Pumice Plain.

Figure 7. View of old roadbed looking west towards JRO from just above researcher parking lot.

Figure 8. Remnants of the 1980s access route for Spirit Lake pumping operations.

The last few miles of the old road bed have been allowed to naturally deteriorate, resulting in deep gullies that have completely obliterated the road in several locations; however, most of the template along the alignment exists to a level that very little reconstruction would be required.

Where reconstruction would need to take place is coming into and out of drainages, and in certain narrow areas. These are narrow areas of the road bed with eroding rock or pumice. These are most notable near the beginning of the trail and potentially near the end of the trail as the trail climbs up onto the hummocks, and other isolated locations.

Figure 9. Narrow Trail Section.

Figure 10. Narrow Trail Section with Pyroclastic Deposit.

In order to cross these narrow sections, an 8-foot wide area is needed. In order to provide this width, excavation on one or both sides may be required to maintain the clearance for tracked vehicle administrative access. Every attempt would be made to avoid earthwork in the Pumice Plain and to track equipment and UTVs over existing grades. The initial narrow section length is

approximately 500 feet represented in Figure 9. A second narrow section represented in Figure 10 is approximately 250 feet in length.

Long-Term Access for UTVs to South Shore Boat Launch
The proposed administrative motorized route generally follows the Truman Trail which follows the 1980s pumping station road bed. At the intersection of the proposed administrative motorized route and Willow Springs, an additional motorized route would be authorized to Spirit Lake south shore to facilitate administrative boat access.

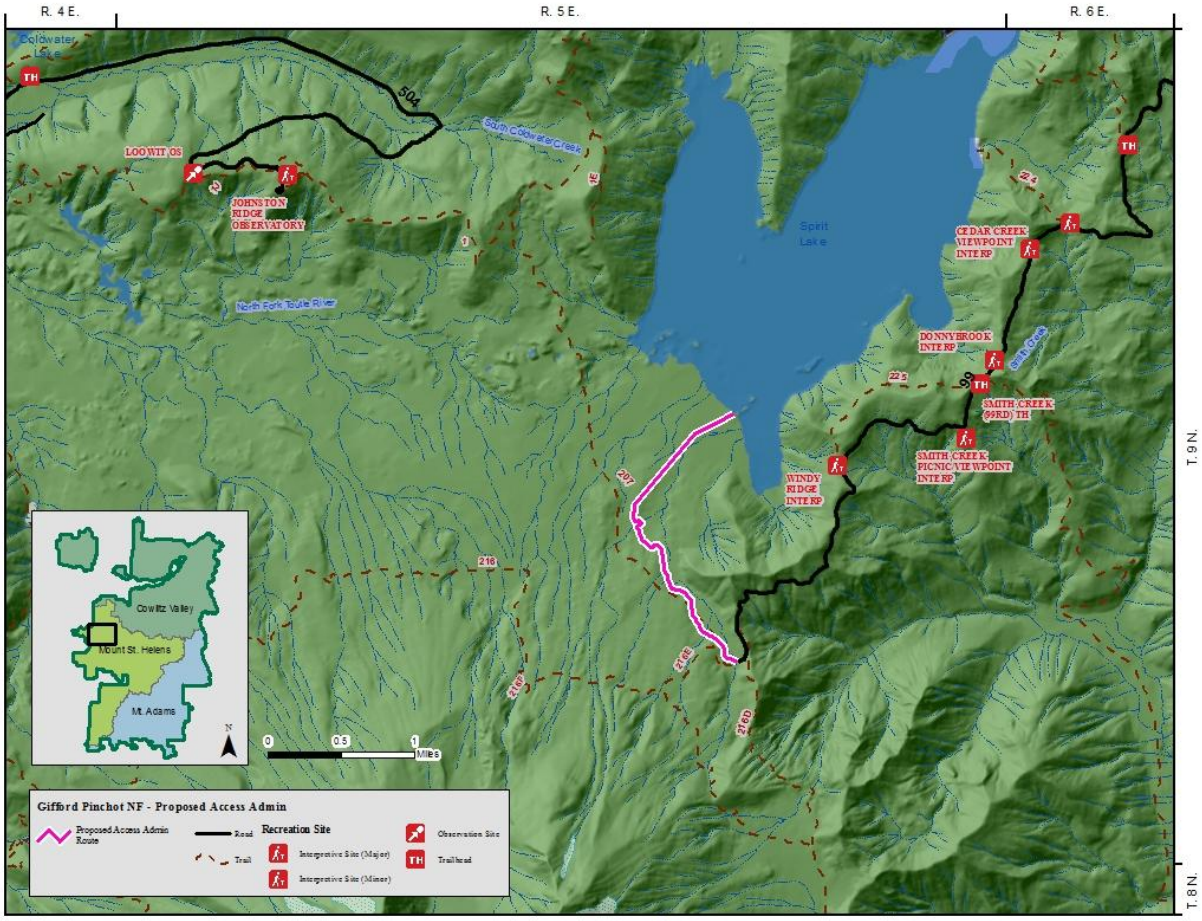


Figure 11. Proposed Action Administrative Route for Long-Term Maintenance.

A route would be located on riverwash (wash) material adjacent to the Willow Springs channel. The route would be within the wash, adjacent to and not in the active channel to minimize sediment transport in the active channel, as well as minimize disturbance to riparian plants and bank slopes. The route would require the removal of rock material that is six inches in diameter and larger out of the access route as storms reworked the substrate (assumed to be at least on an annual basis, but is dependent on individual storm events). The channel is highly dynamic and as the channel shifts due to the bedload in the system, material on the administrative route may need to be moved by hand or a small excavator. The channel and wash width varies greatly so the route would stay adjacent to existing active channel and within the wash. The access route

alignment would vary annually based on channel migration. Stream crossings may be required but would be shallow and require minimal cuts or fills. Limited cutting of vegetation may be required on occasion to facilitate access. Access through Willow Springs may require a substrate made out of cobble sized rocks to act as a stable trail bed to ford the creek.

Figure 12. Drainage from Willow Springs Looking North to Spirit Lake.

Stream Crossings

There are multiple drainages that must be crossed, and they have down-cut through pyroclastic deposit to the debris avalanche in most places. Where pyroclastic deposits still make up the banks of the drainages, the banks are near vertical, and are 10-15 feet high in places along the alignment.

Within the drainages, there are also multiple locations where willows have established. These willows may need to be cut flush, or nearly flush (or tracked over) with the ground elevation to allow access.

In general there are three types of riparian crossings along the 1980s pumping access road through the Pumice Plain:

1. Crossings through annual or perennial creeks that require minimal cuts or fills.
2. Shallow riparian channels (banks greater than three feet, up to seven feet deep) with steep side slopes, resulting in relatively steep grades of up to 15 percent ranging in length of 20 feet to 50 feet on each side of the channel, leading in and/or out of annual or perennial creeks.

3. Deep riparian channels (greater than 7 feet, up to 15 feet deep) with steep side slopes, resulting in relatively steeply graded motorized route of up to 15 percent ranging in length of 50 to 100 feet on each side of the channel, leading in and/or out of annual or perennial creeks.

The following are descriptions of options for improving these crossing areas.

For riparian channels with banks that gradually enter the channel or banks that are approximately 3 feet high or less and shallow riparian channel crossings, minimal work may be needed to ensure a 15 percent maximum slope. Some of these crossings included annual or perennial streams and includes riparian areas with willow trees and other vegetation. Limited cutting for improved visibility and use of existing vegetation to cross areas with potential use of hand tools to arrange rocks and material for crossing. May require frequent reworking if the stream substrate is highly mobile.

Figure 13. Example of gradual riparian channel.

Figure 14. Example of shallow riparian channel.

In order to cross the steep-sloped crossings, a maximum slope of 15 percent is required on either or both sides of the crossing depending on the geomorphic characteristics of the specific crossing. For example Willow Creek crossing has a shallow entrance from the south and steeper exit to the north. The area near the hummocks closer to the south shore helispot may contain both steep entrances and exits, and there may be opportunities to route around. Maximum grades entering drainages are assumed to be 15 percent. The cross sections show the maximum cuts required when entering or exiting a drainage and are dependent on the depth of the drainage being crossed and the alignment of the trail when entering the drainage (Figure 15 and Figure 16).

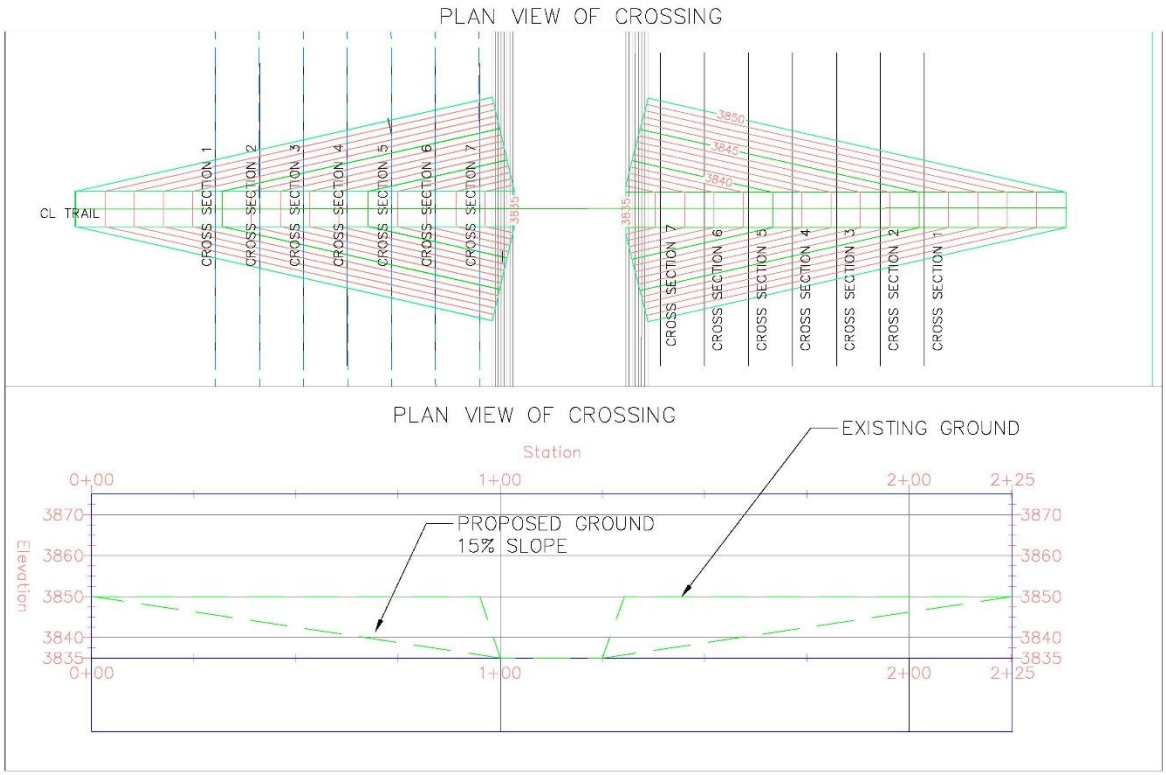


Figure 15. Plan view of stream crossings needed for equipment.

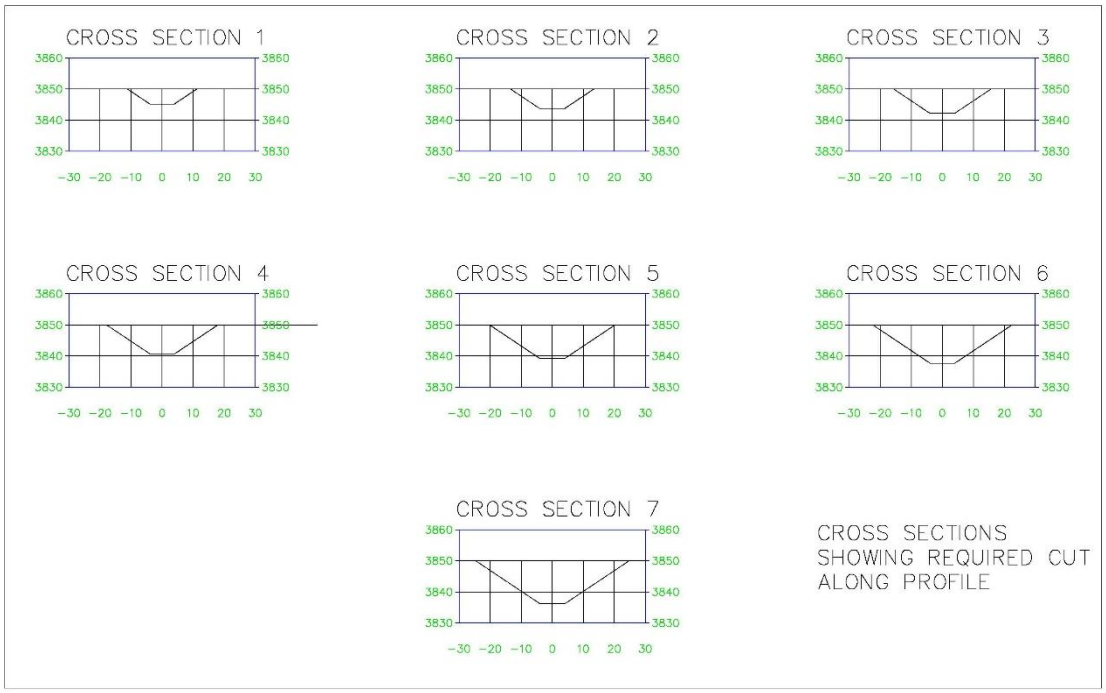


Figure 16. Cross sections of stream crossings needed for equipment.

Figure 17. Example of a steep-sloped crossing.


Figure 18. Crossing at Willow Springs.

As the general area is highly erodible and dynamic due to geologic features and weather, each crossing would be excavated and graded to designed slope and crossings would be reworked and maintained with hand tools and native materials.

Future Administrative Use of Trail
The trail will only be used for limited administrative use; it will not be open to the public. Administrative access could range from one time per year for tunnel gate closure and associated annual tunnel inspection, to daily trips during maintenance or construction activities. It will be used during those months free from snow.

A typical operation and maintenance activity would begin with Monument staff using a utility terrain vehicle down motorized route to the south shore of Spirit Lake (5 miles from Windy Ridge Recreation Site or 3 miles from Researcher Parking Lot). Individual crossings and narrow areas may need scouting and hand tool work each field season to allow for utility terrain crossing. Staff would then transfer to workboat to continue to tunnel inlet area one mile over water to access intake structure for gate opening/closing, and operations and maintenance activities.

Currently the Forest Road 99 Extension is gated and locked at the south end of Windy Ridge Recreation Site. At the terminus of the Forest Road Extension the Research Parking Lot includes large boulders to prohibit access further north along the Pumice Plain except to permit research access.

To educate Monument visitors and enforce regulations, signs would continue to be placed at closure to reinforce existing Monument rules that recreational visitors must stay on existing trail. The existing environmental conditions degrade recreational signing due to effects of snow, ash, rain and wind in the volcanic landscape. New or restored signs to reaffirm Monument regulations will be installed or maintained.

Current public education of trail rules occurs through signs and interpretive education rangers at Windy Ridge Interpretive Site and other portals to Mount St. Helens National Volcanic Monument developed recreation areas.

Details of Geologic Investigations
The geologic investigations will begin with surface mapping utilizing exposed scarpes and ground based remote sensing techniques. The information gained by these less invasive methods will inform the exact drilling locations from which to gain additional cores and instrument monitored groundwater wells and piezometers. The drilling will include a series of test holes to remove cores samples for further study along the northern part of the Pumice Plain, the six-square-mile area buried in ash following the 1980 eruption. Core samples would be collected at a maximum of 25 site locations.

In 1982 and 1983, the U.S. Army Corps of Engineers and the U.S. Geological Survey conducted subsurface exploration to:

- determine the geotechnical characteristics of the debris blockage,
- obtain samples of subsurface material for laboratory analyses,
- monitor groundwater levels,
- obtain data on the distribution of various materials and their in situ properties within the debris blockage.

Currently, the U.S Forest Service is working with the U.S. Army Corps of Engineers to evaluate the 1980s coring data for the debris blockage and identifying data gaps and areas to validate subsurface geological composition (Figure 6). The geotechnical drilling locations will meet the objective of filling data gaps and validating 1980s drilling to improve understanding of the debris blockage and its relationship with Spirit Lake water level elevations.

Drilling will occur for one or two field seasons. At the drill location, the actual boring is 4 to 5 inches in diameter. However, at each boring location a work area of approximately 20 feet by 20 feet would be established. Within the work area, surface disturbance may occur, due to tracked vehicle movement and drill rig placement. Equipment would drive from drill site to drill site.

The drilling consists of continuous split spoon sampling, standard penetration test sampling, and packer tests. Continuous split spoon sampling consists of a hollow metal casing driven in to the ground to collect earth and rock samples at depth. These tests provide the geologic makeup of the subsurface. Standard penetration tests consist of a weight dropped on a metal span with the number of blows per 6” penetration measured. Each exploratory hole would be logged, standard penetration tests performed, and material samples collected for lab testing. Packer tests involve pumping water into the boreholes to test for permeability and groundwater movement. Sampling would be continuous unless deemed to be unfeasible at the time of drilling. Nested or multilevel piezometers would be installed at locations determined by the Forest Service. Piezometers measure subsurface groundwater levels. Locations of all borings and field samples would be surveyed with a tolerance of (+/-) 0.5 feet in both horizontally and vertically.

The driller would be responsible for transport of required water for drilling operations. Drafting out of Spirit Lake or North Fork Toutle River and tributaries with flow sufficient for pumping

without channel modifications would be allowed. The Forest Service or authorized official would designate drafting site(s). Drafting equipment shall include a screen around the intake (foot valve) with openings no larger than 3/32 - inch. An air gap or positive anti-siphon device shall be provided between the water source and water being used for tank mixing with any other materials. The water source would be Spirit Lake or a sufficient sized creek. If using Spirit Lake as a water source, multiple pumps may be required since direct vehicle access to the lake may not be feasible. Materials must be readily available and appropriate measures taken to prevent petroleum products from entering the water source. No water pumped sources potentially contaminated with aquatic invasive species will be allowed to get into other non-connected water to avoid the potential transport of aquatic invasive species. Additionally all pumping equipment will be cleaned using the latest Forest Service protocols before being used and after use.

Rocks and soils displaced by the drill process will be discarded in a stable area to reduce risk of sediment delivery to streams, Spirit Lake or wetlands. Ground disturbance will be minimized to the extent possible to reduce risk of surface erosion and sediment transport and delivery. Core samples from the boring process will be packaged and removed for characterization study.

The drilling machine requirements would consist of a track-mounted drill capable of wire-line core drilling to a maximum depth of 300 feet, obtaining a 2.5 inch diameter core, and standard penetration tests and samples for the full depth specified by the Forest Service. Most drill holes would be drilled to depths less than 100 feet. Wire-line core drilling allows for removal of earth and rock core samples without stopping the drilling process. On completion of the each borehole, the boreholes would be backfilled in a manner that prevents collapse of the surrounding material into the borehole, or ground water measuring equipment would be installed.

Equipment such as a Burley 4500 or 5500 geotechnical drill would be used to conduct the coring. If the drilling equipment needed to perform the sampling activities cannot be flown in due to cost, it would be transported using tracked or low pressure wheeled transport vehicles.

Noise levels would be consistent with geotechnical drilling activities such as diesel-engine tracked vehicles operating continuously until core sample depth is reached, and operation of generators to provide auxiliary power. For example, the approximate overall noise levels with the drill rigs mounted on tracks is 100 dBA measured at the location of the operator, 75 A-weighted decibels (dBA) at 50 feet from equipment, 70 dBA at 100 feet from equipment, and 65 dBA at 150 feet from equipment. Four-wheel, all-terrain vehicles and UTVs would be allowed for daily access to and from drilling locations.

Figure 19. Examples of track-mounted drill equipment.

Alternatives Considered

Alternative 1. West Access – JRO to South Shore
Access from Johnston Ridge Observatory to South Shore Spirit Lake

An alternative to the proposed action includes constructing an eight-foot wide motorized route from Johnston Ridge Observatory to the south shore of Spirit Lake for limited administrative use. This access route would serve the same purposes: facilitate ongoing seasonal operations and use for one or two seasons for geotechnical drilling.

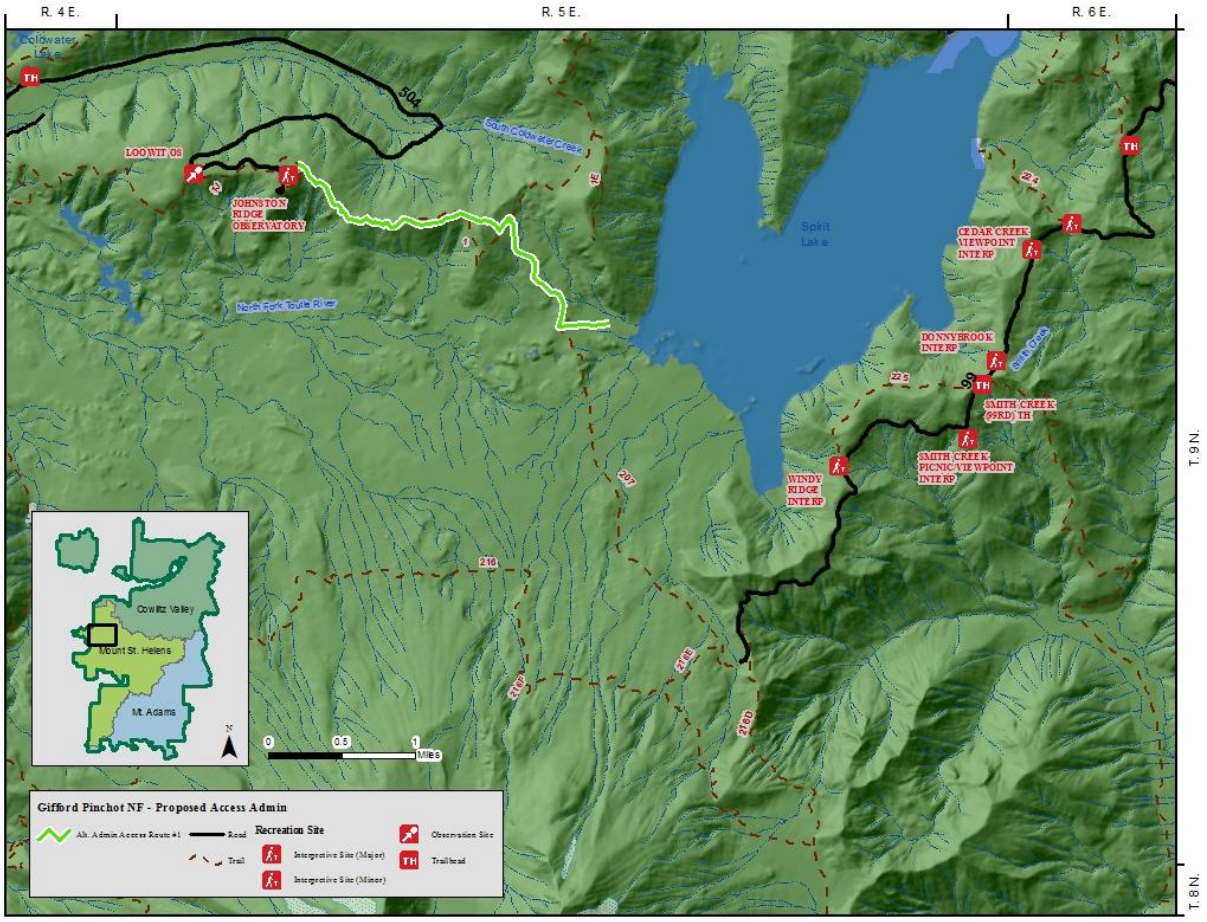


Figure 20. Map of Alternative Route for Drilling and Long-Term Maintenance.

Access for Drilling Equipment
To facilitate access, a three mile route would lead from the northeast corner of the Johnston Ridge Observatory parking lot (off State Route 504) to the south shore of Spirit Lake.

State Route 504 provides access to the U.S. Forest Service facilities such as Coldwater Maintenance Facility, Mount St. Helens Science and Learning Center at Coldwater and Johnston

Ridge Observatory. The Washington Department of Transportation maintains State Route 504 including snowplowing from Interstate 5 to a locked gate just east of Coldwater Lake Recreation Site.

The access would generally follow and expand or parallel the footprint of three popular recreation hiking trails (Eruption, Boundary and Truman trails.) Once improved and constructed, the motorized administrative access route would be used for one or two field seasons by tracked drilling equipment to retrieve core samples and for season (May through October) and for recurring maintenance and repair activities at the Spirit Lake tunnel intake structure.

Constructing the trail will require areas of full bench construction, or balanced cut and fill construction, depending on the existing cross slopes. Most of the existing template along the alignment is approximately 18”-36” wide with grades up to nearly 20 percent. Access on this alignment, assuming the need to use the trail for administrative access, should be limited to grades of less than 15-20 %.

Figure 21. Boundary Trail from Johnston Ridge.

Figure 22. Example of trail stretch with steep cross slopes.

Blasting would be required on up to 10% of the trail depending on the actual alignment chosen to ensure an adequate width for administrative use. Many of the locations may also require full bench construction, which would require placement of that material in another location along the trail to balance the material quantities.

Figure 23. Example of where blasting would be necessary.

Much of the trail substrate likely will not require additional aggregate reinforcement, but there are a few areas where the trail passes through what appear to be ash cloud deposits, that are highly erosive and likely will need some mitigation like armoring the trail with aggregate to reduce the rate of erosion on the trail.

Additional work may be required on the north side of the debris avalanche deposit around some of the Hummocks. There are locations where the trail will have to cross a few drainages, and these locations appear to produce debris flows on occasion based on the deposits seen in the channel during the field investigation. The trail coming down to the hummocks likely has interbedded rock layers. The frequency of bedding planes could not be identified on the surface, but if the path undermines these bedding planes, rock fall into the path should be expected, or additional rock anchorage may be required.


Figure 24. Traversing through hummocks will require nearly full width excavation through the hummocks to maintain grade.

There is one location at the intersection of the Boundary Trail and the Truman Trail where either a substantial fill would be required, or a retaining wall would need to be constructed to maneuver a switch back to reverse directions and maintain grade.

Stream Crossings
There are some drainages that must be crossed as Johnston Ridge and Harry's Ridge slopes down to the Spirit Lake south shore.

The drainages are dynamic, with sediment bedload causing them to shift locally. Most fords through streams likely will rework immediately within the drainage by the following year, and the access route in those sections will naturally become obliterated.

Within the drainages, there are also locations where willows have established. These willows may need to be cut flush, or nearly flush with the ground elevation to allow access. The willows also may be bent over and driven across through the fords.

The alternative access crossings are through annual or perennial creeks that require minimal cuts or fills. The following is a description of options for improving these crossing areas. For riparian channels with banks that gradually enter the channel or banks that are approximately 3 feet high or less and shallow riparian channel crossings, minimal work may be needed to ensure a 15 percent maximum slope. Some of these crossings included annual or perennial streams and includes riparian areas with willow trees and other vegetation. Limited cutting for improved visibility and use of existing vegetation to cross areas with potential use of hand tools to arrange

rocks and material for crossing. May require frequent reworking if the stream substrate is highly mobile

The area near the hummocks closer to the south shore helispot may contain both steep entrances and exits, and there may be opportunities to route around.

As the general area is highly erodible and dynamic due to geologic features and weather, each crossing may have to be excavated and graded to designed slope and crossings would be reworked and maintained with hand tools and native materials.

Future Administrative Use of Trail
The trail will only be used for limited administrative use; it will not be open to the public. Administrative access could range from one time per year for tunnel gate closure and associated annual tunnel inspection, to daily trips during maintenance or construction activities. It will be used during those months free from snow and annual debris.

A typical operation and maintenance activity would begin with Monument staff using a utility terrain vehicle down motorized route to the south shore of Spirit Lake (3 miles from the Johnston Ridge Observatory Parking Lot.) Individual crossings and narrow areas may need scouting and hand tool work each field season to allow for utility terrain crossing. Staff would then transfer to workboat to continue to tunnel inlet area one mile over water to access intake structure for gate opening/closing, and operations and maintenance activities.

To educate Monument visitors and enforce regulations, signs would continue to be placed at closure to reinforce existing Monument rules that recreational visitors must stay on existing trail. The existing environmental conditions degrade recreational signing due to effects of snow, ash, rain and wind in the volcanic landscape. New or restored signs to reaffirm Monument regulations will be installed or maintained. Need to explain objectives of project, why equipment is allowed, care taken and importance of not having trespass (and penalties)

Current public education of trail rules occurs through signs and interpretive education rangers at Johnston Ridge Observatory and Windy Ridge Interpretive Site and other portals to Mount St. Helens National Volcanic Monument developed recreation areas.

Details of Geotechnical Investigations (same as proposed action)
The drilling is identical in location and scope to the proposed action, described above.

Alternative 2. – East Access from FSR 99 Along Windy Ridge to Duck Bay
Alternative Developed Based on Public Comment

This alternative would serve the same purpose as the proposed action: facilitate ongoing seasonal operations and maintenance and provide for drilling of core samples of the debris avalanche.

While the proposed action connected the access needed for the drilling of core samples with the long-term maintenance access by Utility Terrain Vehicle (UTV), Alternative 2 gives the option

to decouple those activities. This was a request brought up by several individuals during the comment period as a way to avoid impacts to ongoing research. Within each activity, some flexibility was built in with various options to achieve the purpose and need.

Access for Drilling Equipment
Option 1: Fly in drilling equipment via helicopter

Option 2: Construct a motorized access route from the terminus of Forest Road 99 extension across Pumice Plain to the core drilling locations utilizing an existing old road bed from the 1980s (described in the proposed action).

Helicopter Access
During the public comment period on the EA, many people strongly encouraged the Forest to use a helicopter to fly the equipment into the drill locations, rather than develop an access route on the ground. The first option would be to fly drilling equipment in via heavy lift helicopter. The heavy lift helicopters have limited carrying: approximately 8,000 pounds or 25,000 pounds depending on the helicopter size class and environmental conditions such as temperature and elevation. Additional limitations involve atmospheric visibility and equipment availability. Drilling equipment would be flown in in pieces, assembled on-site and then tracked from drill site to drill site. Once drilling is complete, equipment would be flown back out. If the drilling equipment needed to perform the sampling activities cannot be flown in due to cost, it would be transported using tracked or low pressure wheeled transport vehicles.

Motorized Access
If flying in drilling equipment is not feasible, the motorized route described in the proposed action would be used. The access route would follow an old road bed that was the location of the post-1980 eruption emergency pumping operation used to stabilize lake levels until the Spirit Lake Tunnel was completed. The route will facilitate access for one or two seasons for geologic investigations. The route leaves the Windy Ridge Viewpoint Parking Lot along Forest Road 99 extension and travels across the Pumice Plain.

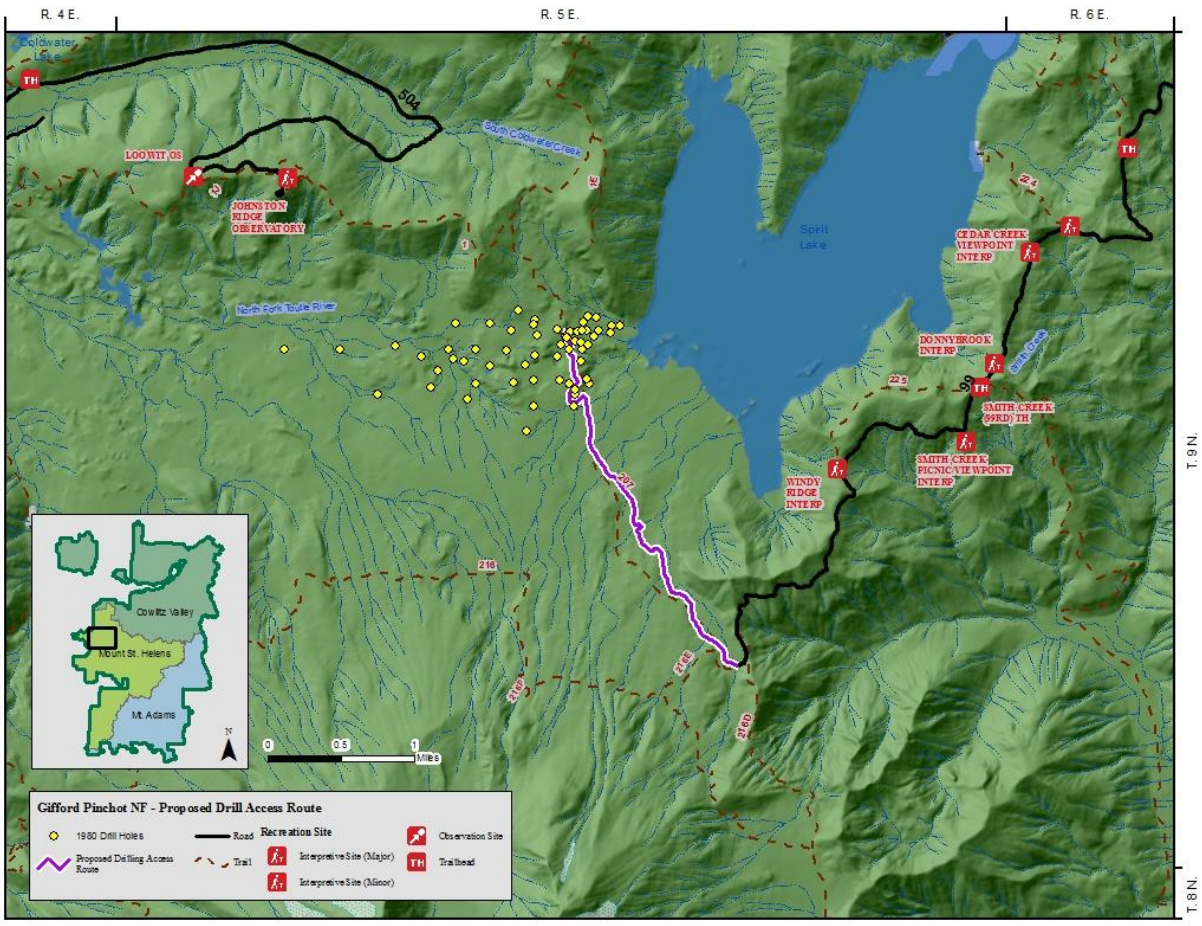


Figure 25. Motorized access to drilling location if equipment cannot be flown in via helicopter. [Note – points on the map indicate the locations of the 1980s drilling and are only shown for reference.]

For a complete description of the work that would need to occur to use this route, see *Access for Drilling Equipment* under the Proposed Action section above on pages 18-21.

Long-Term Access for UTVs to South Shore Boat Launch
Option 1: Construct a route from FSR 99 along Windy Ridge/Forsyth Creek to Duck Bay

Option 2: Construct motorized route from FSR 99 across Pumice Plain to Willow Springs and continue from Willow Springs to Spirit Lake (as described in the proposed action).

The Forest Service in coordination with the U.S. Army Corps of Engineers conducts annual tunnel inspections, and comprehensive periodic (every 5 years) inspections to determine tunnel integrity and to identify repairs. The inspections in addition to an interagency risk assessment have identified maintenance and repairs that will be addressed each field season over the next several years. Additionally, some of the system repairs and upgrades require annual maintenance to maintain their effectiveness. For these reasons, the USFS and administrative entities require recurring access to Spirit Lake and the tunnel inlet during the late spring, summer and early fall field season.

The motorized trail will only be used for limited administrative use; it will not be open to the public. Administrative access could range from one time per year for tunnel gate closure and associated annual tunnel inspection, to daily trips during maintenance or construction activities. It will be used during those months free from snow.

To educate Monument visitors and enforce regulations, signs would continue to be placed at key spots to reinforce existing Monument rules that recreational visitors must stay on existing trails.

Duck Bay Option
To facilitate access, a route from the end of the 99 extension down seasonally flowing, Forsyth Creek to Duck Bay so that it could be used by all-terrain vehicles to cross the section of Pumice Plain between the researcher's parking lot and the southwest shore of Spirit Lake. Once improved, the motorized administrative access route would be used for recurring maintenance and repair activities at the Spirit Lake tunnel intake structure. The modified route from the "Researcher's parking lot" does not utilize any of the Truman Trail and old roadbed. This route goes down this channel and avoids most of the research sites.

Immediately upon leaving the 99 extension a motorized route would be authorized to Spirit Lake via a seasonally flowing channel. This channel rarely has water during the potential season of access and has relatively little active or historic research sites. The route would be located on riverwash material adjacent to the channel but there is minimal floodplain and the stream is steeper so additional crossings (unimproved fords) would likely be needed. About half way down the Forsythe Creek Channel, before it connects with Willow Springs, the route moves east out of the channel along the edge of Windy Ridge and down a ephemeralhuf channel to Duck Bay of Spirit Lake (see map – Figure 26). The route is passable by UTV but will require some additional improvements. It is anticipated that a small piece of equipment would be needed to move boulders to create a path for UTV access. Given the potential for the stream on the Pumice Plain to transport large material even up on to primary and secondary floodplain terraces, there may be a need to occasionally move large rocks and boulders by hand or with the mechanical help of a UTV to allow for the UTV to navigate the route.

This channel has a higher potential to move large material on an annual basis and the annual maintenance is an expected trade-off by using this route. It is expected that approximately 1-2 days of maintenance with a small piece of equipment would be needed to move boulders out of the route to allow for UTV passage. Should the annual maintenance grow in scope (annual excavation needed) or extent (more than 1-2 days) the US Forest Service would use the original proposed route from the 99 extension, down the old roadbed (Truman trail) and down Willow Springs drainage. This is not expected at this time and in no instance would both routes be used.

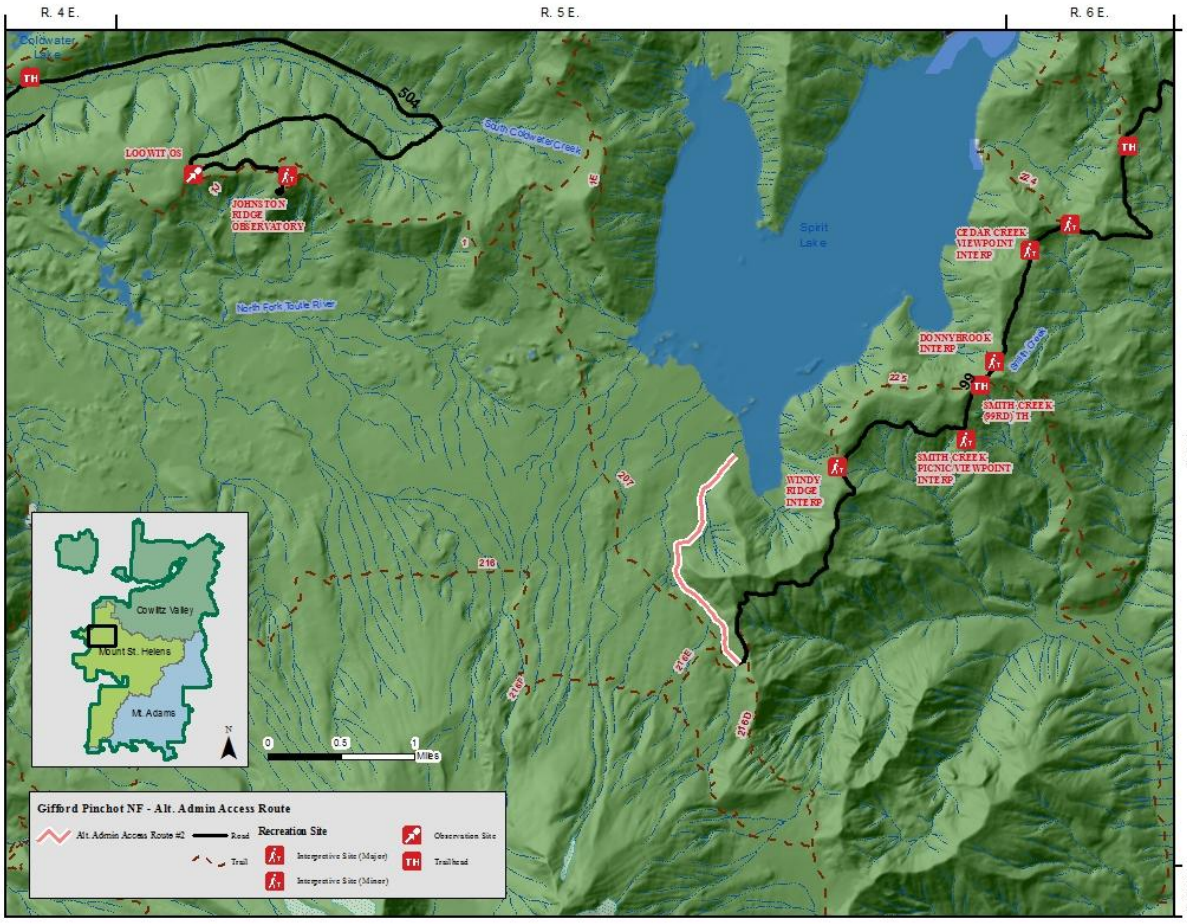


Figure 26. Duck Bay Route Down Forsythe Creek.

Willow Springs Option

This route also leaves from the terminus of Forest Road 99 extension It follows the same road bed as described above for drilling access and then heads north at Willow Springs. This is the same route as described in the Proposed Action.

At the intersection of the proposed administrative motorized route and Willow Springs, an additional motorized route would be authorized to Spirit Lake south shore to facilitate administrative boat access.

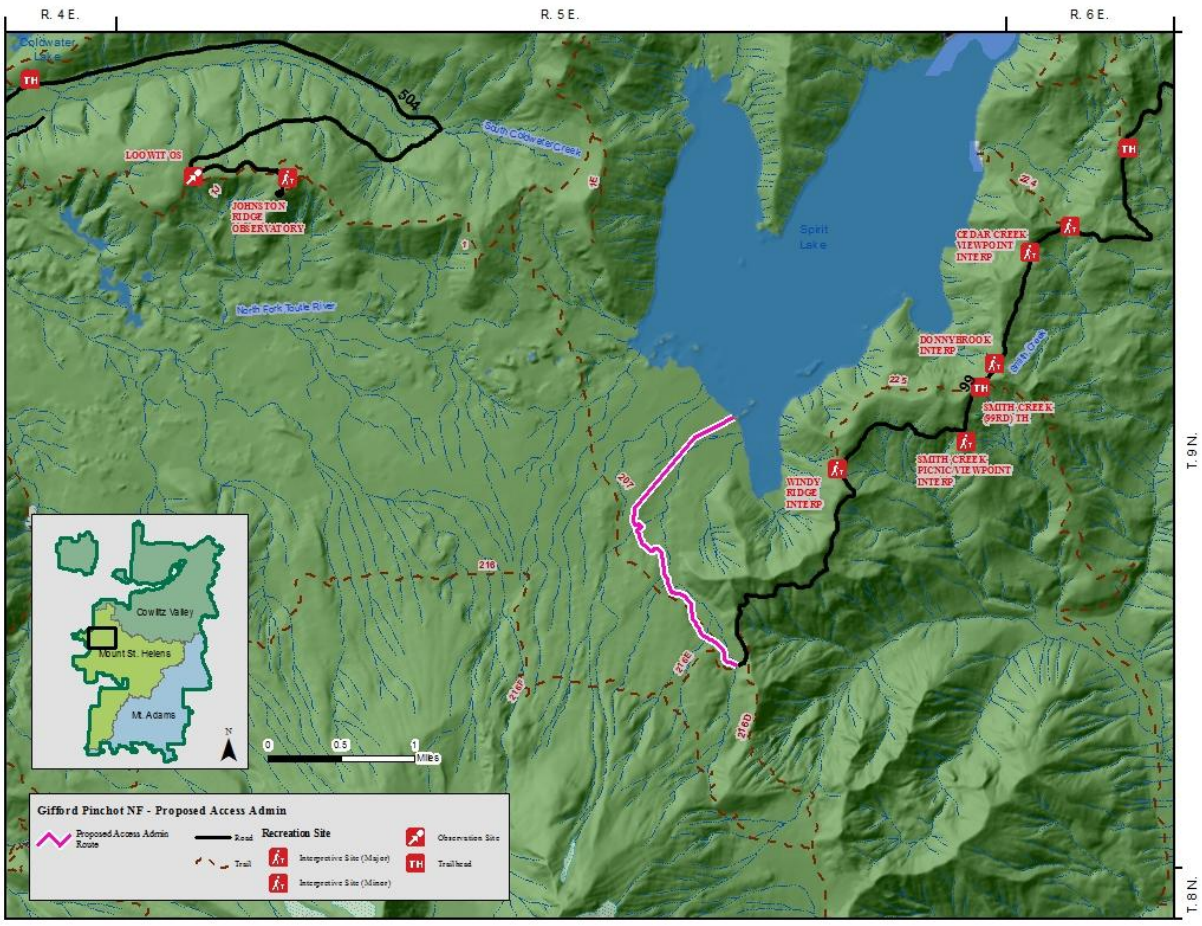


Figure 27. Proposed Option 2 Long-Term Access via UTV.

For a complete description of the work that would need to occur to use this route, see *Long-Term Access from Truman Trail to South Shore Boat Launch* under the Proposed Action section above on pages 22-25.

Details of Geotechnical Investigations (same as proposed action)
The drilling is identical in location and scope to the proposed action, described above.

Design Features, and Best Management Practices

Common to Proposed Action and Alternatives

Research
How the project may affect ongoing research across the Pumice Plain was identified as one of the main concerns. Specific mitigation is included to work with researchers to avoid as much direct impact to ongoing research as possible. Additional project design listed below to protect soils, water quality, wildlife and fisheries, and the spread of invasive species will also aid in avoiding indirect impacts to ongoing research.

- Continue to work with the scientists conducting research on the Pumice Plain when it is feasible during route layout and project implementation to identify any especially sensitive research plots or biological communities. Such discussions may include the location of proposed stream crossings and level of bank modification required.
- Clearly designate and mark sensitive features and research plots and develop clear expectations and standards for operators to follow to avoid sensitive areas and minimize disturbance.

Recreation Resources

- To the extent possible, schedule work to be accomplished on weekdays (preferably Monday through Thursday) when fewer recreational users are utilizing the trails.
- When work is occurring, post signage at trailheads leading onto the Pumice Plains warning recreational uses to expect an increase in trail encounters and noise.
- Staging areas, equipment storage and helicopter landing zones related to drilling and/or route maintenance will be located outside of visual range of the Truman Trail.
- Clean-up and naturalize activities in areas within view of trails including drill site locations and drill site access routes.
- Where feasible drive over willows growing within the old roadbed rather than cutting to limit disturbance.
- Leave vegetation or slash at temporary access points with cut ends facing away from the access route. Where additional controls are necessary, scatter rocks and vegetation over the first 100 yards of temporary access points.
- For any cut vegetation within 10 feet of either side of the access route, cut vegetation level with the ground.
- Maintain wooden trail mileage signs and confidence markers at existing locations.
- In order to reduce impacts to the Truman Trail, drilling equipment will only be allowed to cross the trail at a limited number of designated places.
- Install signage along the 99 Road Extension and the Boundary Trail east of Johnston Ridge Observatory interpreting the purpose of the motorized administrative route, why it is needed, the fragility of the area and its continued status as an "on-trail only area" with no camping or access to Spirit Lake for fishing or on-water recreating.
- Where the motorized access route deviates from the trail and at key locations along the motorized administrative route install signage that reinforces the regulation that recreational visitors must stay on designated trails. Focus signage in and around areas of disturbance and at viewpoints of the lake.
- Update the Forest Service webpages for the Truman Trail to include information about the motorized administrative access route, why it is needed, and to be aware of possible motorized activity along the route.
- Interpretive rangers at Windy Ridge and Johnston Ridge Observatory will continue to emphasize that no off trail travel is permitted on the Pumice Plain within Closure Area 3.
- At stream crossings, confidence markers in the form of tall posts or cairns will be placed on either bank to help recreational user distinguish where to enter/exit. Reinforcement signage stating "stay on designated trail" will also be installed on confidence markers in an effort to reduce the likelihood of off trail travel up or down the drainages.

- Forest Protection Officers will patrol the area performing compliance checks as time and work load allows.
- Place additional interpretive information/signage at Windy Ridge explaining all boat use on Spirit Lake is authorized for either research or tunnel maintenance and that the area is not open to public use.

Soils

- Ground based operations will be confined to approved routes and work spaces during drilling operations. Exceptions include UTVs operating on approved river corridors and approved non-soil locations shown on project map.
- Off-trail drill operations (such as drill rigs) will be accomplished with as little ground disturbance as practicable. Minimize travel on slopes greater than 10% and soft soils, such as what's mapped as Soil Survey Mapping Unit 231.
- Maintain access gates and signs in order to restrict vehicular access to inspected, properly equipped vehicles.
- Off-trail vehicles will not travel on slopes greater than 20%, where erosion would result from wheel or track damage.
- Assess soil for excessive moisture prior to operations. Avoid travel on soils while they are saturated to reduce rutting. Precipitation gauges can be used to determine overly wet conditions. If precipitation is above average levels for a typical dry season, work should be postponed.
- Constrain ground disturbing operations to as few routes as practical, to existing compacted soils, and minimize vehicle traffic as to avoid expanding areas of soil compaction.
- Minimize shoreline use and limit traffic by maintenance workers to one designated trail and work area. Limit permanent equipment storage to one location away from the water on shoreline location with minimal vegetation and outside of possible mudflow/lahar paths.
- Schedule ground based operations during the dry season (June-September) to avoid damage to soils while they are wet.

Wildlife Species

- If possible, clear any shrubs in riparian habitat at stream crossings outside of the nesting season (April 1 until July 15) to minimize impacts to breeding birds.
- Blasting for route access development in Alternative 1 would occur either during late summer or fall to minimize potential impacts to juvenile mountain goats.

Contamination

- If contamination is suspected, discovered, or occurs during the proposed project, testing of the potentially contaminated media must be conducted. If contamination of soil or groundwater is readily apparent, or is revealed by testing, notify the Washington Department of Ecology.

Water Quality-Access Route Construction and Maintenance

- Minimize operation of equipment in and around stream channels and floodprone areas.

- Minimize number and length of stream crossings.
- Select stream crossing locations that will minimize the need for excavation at approaches.
- Where practical, make all stream crossings and approaches at right angles to direction of flow to minimize length of channel impacted.
- Where earthwork is taking place, shape access route for drilling equipment to minimize concentration of surface flow.
- Construct driveable waterbars at sufficient spacing to ensure concentrated surface flows are routed off the access route, and at key locations to prevent concentration of surface flows. Particularly important at the upper end of throughcuts leading to stream crossings.
- Provide sufficient survey and maintenance of the access route to ensure effective surface water drainage.
- Clean all vehicles of petroleum products prior to entering the access route, and inspect for leakage or potentially compromised hydraulic, fuel or cooling systems.
- Place excavation spoils, if any, outside of Riparian Reserves and shape piles to drain.
- Rehab/improve drainage on abandoned sections of existing roadbed in the Pumice Plain.
- Once a section of the access route for drilling equipment is no longer being utilized return the landform to the pre-existing condition as much as possible without causing undo disturbance or changing the landform. This would be to reduce long-term, soil erosion, hydrologic impacts and sediment delivery.

Water Quality-Drilling Operations

- Avoid drilling near surface water bodies where construction impacts may affect surface water quality.
- Avoid excavation and placement of fill in all wetlands.
- Minimize footprint of construction area for drilling operations.
- Provide full containment for all petroleum substances and any other potential contaminants in a location outside of Riparian Reserves and 50’ or more from drilling activities.
- Provide containment around the base of drilling equipment to protect against hydraulic breaks or other spills getting into boreholes.
- Prepare a spill and containment plan for any drilling fluids or fuel storage that is needed onsite, and have all equipment and materials needed to employ the plan at each site.
- Minimize use of fluids in drilling boreholes, and in all cases use fluids that are biodegradeable, and certified for use in potable water supplies by the National Sanitation Foundation / American National Standards Institute (NSF/ANSI).
- Provide a plan for containment of highly turbid water and slurry from drill operations. This plan must be approve by Monument Manager prior to drilling.
- Conduct all drilling, plugging and abandoning boreholes in accordance with Washington State Department of Natural Resources standards and guidelines contained in “Mineral Exploration Well/Drill Hole Plugging and Abandonment” at: https://www.dnr.wa.gov/publications/ger_smr_drill_hole_plugging.pdf?8oaqtz4.

Invasive Plants

- To prevent the introduction of noxious weeds into the project area, all heavy equipment, or other off- road equipment used in the project is to be cleaned to remove soil, seeds,

vegetative matter or other debris that could contain seeds. Cleaning should be done before entering National Forest Lands, and when equipment moves from or between project sites or areas known to be infested into other areas, infested or otherwise. Cleaning of the equipment may include pressure washing. An inspection will be required to ensure that equipment is clean before work can begin. (Equipment cleaning clause Wo-C6.35) (Standard 2).

- No importing of materials (straw, mulch, fill) would be authorized.
- Before access route construction, treat the invasive species at the equipment staging area and where they occur within a ½ mile of the staging area along the route to the project area, using a Forest approved method (use Table 2 from the Botanical Resource Report as a reference). If additional state listed noxious weeds or other non-native species not present in the project area are detected at the access point, these species should be treated as well. Control should occur before seed is set for the year (June or July). The project manager shall coordinate with the Gifford Pinchot South Zone botanist to appropriately time access route construction with weed treatments. Any invasive species control actions should be closely coordinated with scientists.
- Tracks to drill sites and landing areas for drilling machinery should be kept as small as possible to minimize disturbance and damage to moss when leaving the established access route across the Pumice Plain.
- After initial implementation, survey and treatment of noxious weeds and invasive non-native species should occur every field season, ideally before the access route is used for tunnel maintenance. The project manager shall inform the botanist one month before access is planned to allow for weed treatment scheduling. Invasive species control needs to be closely coordinated with scientists.
- The access route should be monitored annually for new non-native and invasive species in the project area to both determine the effectiveness of prevention measures and allow for coordination of treatment and adaptation of measures if necessary.

Fisheries

- Water drafting:
    - The location, pumping rate, and duration of water withdrawals will be designed to minimize aquatic impacts:
        - Stable (i.e. not visibly eroding) locations must be used for water withdrawal vehicle access to the stream and lake.
        - Pumping will not reduce total instream flows by more than 50% in order to protect fish and fish habitat at and/or downstream of the stream water withdrawal sites.
    - Minimize disturbance of riparian vegetation to the greatest extent practicable.
    - If a pump set-up is required, ensure that appropriate spill mitigations are in place:
        - Do all refueling at least 150 ft. away from any waterbody (wetted or dry).
        - Pump set-up will include containment tray and absorbent pads.
        - Entire containment system needs to be level. If necessary, move soil to level the pump setup area and restore it to its original appearance when water withdrawal is completed.
        - The edges of the containment tray will, if necessary, be held upright with sticks and/or rocks so gasoline does not leak out.

        - Gas absorbent pads will be folded lengthwise and placed under the fuel tank. The absorbent pads will be checked and replaced at least daily. If there is a rain event expected or precipitation has begun, the absorbent pads will immediately be checked and, if necessary, replaced and additional absorbent pads will be placed around the inside edges of the containment tray.
        - If water with a gas sheen on the surface accumulates within the containment tray, place the absorbent pad on the surface of the water and allow the pad to absorb the gas (10-15 min). Discard the pad in a plastic bag, pour residual water into a container that can be sealed and discarded appropriately off Forest.
        - Used absorbent pads must be discarded in plastic bags and at an appropriate facility off-Forest.
    - All pump intakes must be screened with material that has openings no larger than 5/64 inch for square openings (measured side to side) or 3/32 inch diameter for round openings, and the screen must have at least one square inch of functional screen area for every gallon per minute (gpm) of water drawn through it. For example, a 100 gpm-rated pump would require at least a 100 square inch screen.
    - Screens will be maintained and cleaned at least once a day in order to prevent injury or entrapment of fish. The screens will remain in place whenever water is withdrawn through the pump intake.
    - If temporary dams are required, they will be constructed of sandbags or bags filled with gravel.
    - No fill from outside the bankfull channel will be used to seal the dam and no logs or woody material will be utilized for construction of the temporary dam.
    - Temporary sandbag/gravel bag dams will be completely dismantled and the streambed restored to its original condition following completion of water withdrawal.

Aquatic Invasive Species

- All personnel, equipment, vehicles, and heavy equipment must follow **Level 2** aquatic invasive species decontamination protocols as prescribed in: *Invasive Species Management Protocols, Version 2* (Washington Department of Fish and Wildlife, November 2012, https://wdfw.wa.gov/publications/01490/wdfw01490.pdf) or the latest/subsequent iterations of the WDFW invasive species management protocols.

Alternatives Considered but Eliminated from Detailed Study

Helicopter Access for Drilling Equipment:
In the original proposal, the Monument Manager considered flying in the drilling equipment. This alternative was not carried forward in the EA when it was published for a 30-day comment period because of its added cost and the fact that it doesn't provide for long-term, motorized access for long-term maintenance.

NOTE: After hearing from the public and researchers during the public comment period, Alternative 2 was developed and does include flying drilling equipment in to the drilling locations.

West Access – Toutle River
Spirit Lake south shore access from west side State Route 504
An alternative was considered that would access Spirit Lake from the west and travel up the Toutle River. The route is approximately 5.5 miles and may require long-span bridges to cross ravines, river and stream crossings and gorges. The popular recreational Boundary Trail is adjacent to some of the route. This alternative was not carried forward in the analysis because of the initial and ongoing infrastructure expense to provide for one time drilling access and limited administrative access to complete operations and maintenance projects at Spirit Lake outlet.

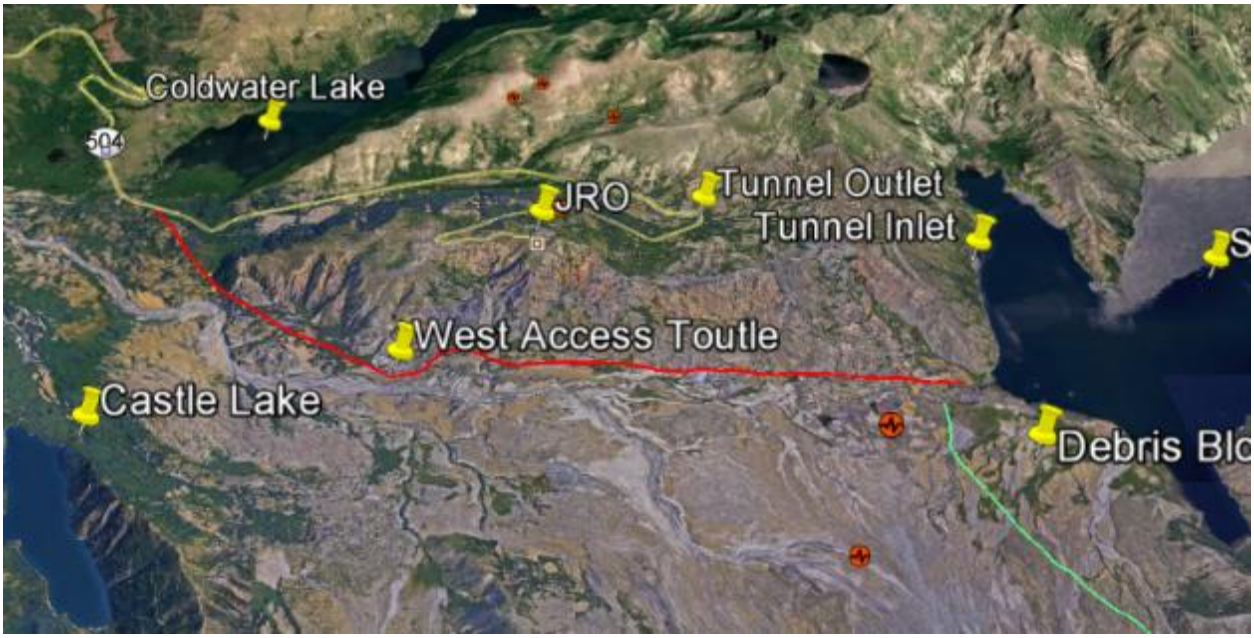


Figure 28. Alternative access via the Toutle River that was not carried forward.

Figure 29. Toutle River with view of hummocks and debris blockage.

THE AFFECTED ENVIRONMENT

This section describes the current environment in the project area.

Location

The proposed project is within the Mt St Helens National Volcanic Monument in the upper portion of the North Fork Toutle River subwatershed (HUC-1708000505) in southwest Washington. The Toutle River is a tributary to the Cowlitz River. The proposed project is located in the blast zone on the north slopes of Mt St Helens. The entire landscape on which the proposed access route and drilling is proposed was reset by the eruption and failure of the north side of the mountain in 1980.

Climate

Elevations in the project area range from approximately 3,480 feet at Spirit Lake to over 4,300 feet on Johnston's Ridge at the upper end of the northern access alternative, and near 7,000 feet at the headwaters of streams flowing off the south slopes of Mt St Helens. Located in the western Cascades, climate in the planning area is characterized by warm, dry summers and wet winters. Much of the project area is in the snow-dominated precipitation zone, with rain-on-snow likely occurring at times in lower elevations of the project area.

Landscape

In general, the proposed access route crosses a relatively broad, gently sloping landscape that is composed of landslide deposits overlain by pyroclastic debris. Soils have developed from three basic types of parent material-flow rock of andesite and dacite, volcanic tephra deposits of ash and pumice, and transported material including alluvium, mudflow, lahar, and landslide debris. Soils of the project area were mapped as part of the Soil Survey of Skamania County Area, Washington (1990). Obscurity soils, named in the survey, formed in mudflow material and occur on broad fans and low terraces on the north-, west-, and east-facing slopes of Mount St. Helens. These soils are very deep and somewhat excessively drained. The surface texture is sand, full of boulders, overlying a loamy sand full of cobbles.

Mount St. Helens' volcanic cone consists of lava flows of olivine basalt and pyroxene andesite that surround a summit plug of dacite. Valleys adjacent to the volcano are filled with pyroclastic flow material, lahar, and alluvium, mixed with layers of tephra.

On May 18, 1980, Mount St. Helens released a giant landslide mixed with mud and ice that plunged into nearby Spirit Lake and also filled the North Fork of the Toutle River valley with forested mountainside, rocks, glaciers, and soil, as much as 200 meters deep. As the landslide moved away part of the mountain, pressurized magma inside the mountain released a powerful volcanic eruption, destroying an even larger area 8 by 15 miles wide.

Additional eruptions in 1980 were reported on May 25, June 12, July 22, August 7, and October 16 and 17, adding fresh deposits of pumice and volcanic ash to 35,000 years of tephra influence on local forest soils. September 2004 to June 2006, mild volcanic eruptions built up a rock dome, staying mostly confined to the crater; eruptive activity stopped in January 2008.

A number of streams have incised through these coarse, uncohesive materials, eroding out channels that range from narrow, willow-lined streams to wide, inset floodplains with multiple or anastomosing channels. Toward the lower end of the planning area are broad alluvial fans and deltaic deposits developed since the eruption, as the sediment-laden streams approach and enter Spirit Lake. Avalanche and debris flow deposits are evident in the channels and surrounds.

Topography along the norther portion of the planning area, where the alternative route would be located, include steeper slopes associated with Johnston's Ridge and Harry's Ridge. Valleys and ridgelines are more established in this landscape that pre-dates the eruption. Bedrock outcrops are evident throughout, and drainages are presumably more well-established and less active than those on the Pumice Plain.

Hydrology and Streams

Streams crossed by the proposed access route drain the north slopes of Mt St Helens and flow to Spirit Lake by surface flow, or lose their flow to subsurface approaching the lake. Spirit Lake drains by a regulated outlet to the South Fork of Coldwater Creek. Coldwater Creek is a tributary to North Fork Toutle River, which flows to the Toutle River, and then to the Cowlitz. The Cowlitz River enters the Columbia River near Longview, Washington. The National Hydrography Dataset shows 5 perennial streams and 6 intermittent streams crossed by the proposed access route. However, this underestimates what is on the ground. Google Earth

imagery indicates there are closer to 20 channels in the project area, with a wide range of surface flow in terms of seasonality and spatial extent.

Streams in the project area drain relatively small catchments of up to two square miles in size. Peak streamflows have not been measured on any of these streams, but Streamstats analysis projects a bankfull flow of roughly 200 cubic feet per second (cfs) on the larger of the streams, and a 100-year flood of over 600 cfs on that stream.

Streams in the planning area have not been surveyed to Level II protocol and are not well-described in literature, but appear to be highly dynamic, and lacking in woody debris and tree roots that would provide structure and add to the integrity of streambanks. Habitat features are poorly developed as a function of the frequency of channel change.

Spirit Lake Blockage

Spirit Lake is blocked by the 1980 rockslide-debris avalanche and subsequent blast deposits. Studies of the debris dam stratigraphy and soil properties, and of erosion on the surface of the blockage, have led to concern that the lake may someday breach through or spill over the blockage (USGS Water-Resources Investigations Report 82-4125) and cause significant damage.

The mixed nature of the debris avalanche makes prediction and mapping difficult. Soil and rock types could vary drastically between two nearby points due to mixing that occurred in the avalanche, and such differences are hidden underground. Further, erosion by water and wind has considerably affected some deposits. Thus, it is important to understand the limitations in interpreting soil and geologic information, especially concerning the debris avalanche deposits.

Soil Conditions

Volcanic activity of Mount St. Helens destroyed soil productivity in the planning area by removing all soil materials. Soil building and recovery in the natural environment continues in a balance of biological, physical, and chemical activity acting on the soils. Changes to the affected area from access trails and recreation activity have stabilized as far as new soil disturbance.

Studebaker soil series was mapped on the debris avalanche, and the Panhandle series was mapped on the pyroclastic flow. During the later stages of the May 18 eruption and later eruptions of 1980, mudflows and pyroclastic flows streamed over a part of the debris avalanche. Obscurity soils were mapped on these mudflows. Soils covered with pumice or volcanic ash up to 20 inches thick are mapped as “overblown phases” of the soil series.

Panhandle soils represent the surface of what is mapped as pyroclastic flow deposits. This area is relatively unique, relatively sensitive to disturbance, and poses perhaps the greatest threat to the debris dam stability. The soils require a high level of care during development and use to remain within the intent of the Act.

Soils are rated as suitable for recreational use, offering scenic vistas, points of geologic interest, and alpine lakes for hiking or trail riding. Soil characteristics have developed unaided by human intervention and are unique in that new soil series were published by the 1990 Soil Survey of Skamania County to describe them.

Soil Formation

A property of soil expressly protected in the CMP is Soil Formation. Soils in the activity area are considered "young" because they are in the process of adjusting to the environment after a significant disturbance, and actively developing toward a dynamic equilibrium. The ecological capacity or hydrologic function of soils can be altered in response to natural or human caused disturbances by changing physical, chemical, and biological properties. A Biophysical Sensitivity Rating of 4 out of 5 means a High level of care is needed to remain within the intent of the CMP.

Erosion

Soil layers on the Pumice Plain and hillsides have begun to stabilize with vegetation and other soil-forming elements. Since their deposition, easily eroded tephra and ash have settled and sensitivity to erosion has steadily reduced, but the area remains in a sensitive state of early stages where erosion could cause problems if bare soils are exposed. A Biophysical Sensitivity Rating of 4 out of 5 in the CMP means a High level of care is needed.

Pyroclastic Flow Features and Spirit Lake Shoreline

The soils of the Panhandle series and associated volcanic deposits are relatively unique and sensitive to disturbance. Pyroclastic Flow deposits are documented in the CMP as needing care during development and use. Features of concern include fluvial features, sink holes and phreatic explosion pits, and unique surface textures. A Biophysical Sensitivity Rating of 4-5 out of 5 means a High to Very High level of care is needed.

Deterioration of the 99 road extension deterred drivers from reaching the end of the road until 2017, when reconstruction repaired deep ruts.

Water Quality—Temperature and Turbidity

No streams in the planning area have been identified on the 303(d) list that indicates impaired water quality. Stream shade varies widely in the planning area from reaches that lack vegetative or topographic shade throughout the day, to reaches that are lined in willow thickets, and that may have full shade throughout the day during summer months. Streams draining this area typically have intermittent surface flow, so there is little surface water that would be exposed to direct solar heating during the late summer period when water temperatures typically reach their annual maximums.

Based on the lack of forest cover, duff, and cohesive soils in this heavily impacted landscape, erosion rates across the Pumice Plain are presumed to be high in comparison with forested environments. Fluvial erosion is also occurring at relatively high rates, as evidenced in the deeply incised floodplains and channels crossing the Pumice Plain. Combined with the extensive alluvial deposits near Spirit Lake it is clear that streams in the project area carry a substantial sediment load and would have high turbidities during periods of higher flow, or in response to mass wasting or other disturbance.

Plant Life

The ensemble of volcanic processes associated with the eruption caused instant large scale landscape disturbance with distinct disturbance zones, each of which had varying impacts on plant communities. The project areas falls mainly within the pyroclastic flow zone, which was sterilized by the direct volcanic blast, and then buried in pumice (Moral et. al. 2012). Some vegetation was retained in a few gullies, but it was mainly a barren landscape immediately post eruption. In the 37 years following the eruption, the Pumice Plain, and surrounding disturbance zones, have been some of the most active research sites on post disturbance succession. The unique early successional plant communities of the Monument make it a high value natural area. Detailed information on the successional trajectories of different areas can be found in Crisafulli et al. 2005, and specifically about the Pumice Plain in Moral et al. 2012.

Cover and density of vegetation increased slowly after the eruption, where today the area is dominated by two moss species (*Polytrichum juniperinum & Racomitrium canescens*) and other forbs, with some graminoids interspersed throughout. Common species include pacific lupine (*Lupinus lepidus),* giant red Indian paintbrush (*Castilleja miniata),* fireweed *(Chamerion angustifolium),* hawkweed (*Hieracium sp.),* chamisso sedge (*Carex pachystachya),* parry's rush (*Juncus parryi),* and Cardwell's beardtounge (*Penstemon cardwellii).* Common non-native species include cat's ear (*Hypochaeris radicata),* sheep's sorrel (*Rumex acetosella),* and meadow hawkweed (*Hieracium caespitosum)* in wet areas. Additionally, Sitka alder and Sitka willow (*Alnus viridis* and *Salix sitchensis*) are well established in riparian areas.

Before the eruption, the plant communities surrounding the volcano were biologically diverse and mainly forested. Interspersed throughout the landscape were some young aged plantations from re-vegetation efforts in recent clear cuts. However, the level of disturbance that occurred in the project area makes it very unlikely habitat for any of the Forest's sensitive plant species. On the other hand, this disturbance contributes to Monument ranking as is a high priority area for invasive weed treatment (GPNF invasive plant treatment project EIS, 2008).

Fisheries

There are no Federally-listed or Forest Service Sensitive fish in or downstream of the project area. There are some activities proposed on, or near, streams feeding into Spirit Lake that contain rainbow trout. These rainbow trout are believed to have been illegally stocked in Spirit Lake following the eruption of Mount St. Helens and are also believed to be spawning and at least seasonally present in the streams that drain into Spirit Lake. In early 2018, the Monument Manager was made aware of the detection of the New Zealand mud snail (*Potamopyrgus antipodarum*) in a stream that drains into Spirit Lake. Additionally, stomach samples from fish in Spirit Lake were also positive for the snail (see Charlie Crisafulli's Assessment of the Spatial Distribution of New Zealand Mud Snail in the Spirit Lake Basin, in the project file).

Wildlife

A Forest Service wildlife biologist evaluated the project for impacts to listed wildlife species. The list of species included federally-listed species under the Endangered Species Act, Forest Service Sensitive Species, Forest Service Survey and Manage Species, Gifford Pinchot National Forest Management Indicator Species, and Neotropical Birds. Species documented to occur or

those with potential habitat present include the gray wolf, mountain goat, pileated woodpecker, willow flycatcher, deer and elk, birds associated with hardwoods (such as the orange-crown warbler) and nesting birds (such as the common nighthawk).

Wolverines are associated with montane environments and sub-alpine habitat in Washington and also typically avoid areas of high human use. No wolverines have been documented recently in the area. Mountain goat numbers on the Monument have seen a steady increase in recent years and currently there are an estimated 250 goats. Pileated woodpeckers are listed as present on the Pumice Plain, but are probably using habitat there for foraging. Bird species associated with hardwoods, use shrubs in the area. Van Dyke salamanders have habitat near the Pumice Plain.

Recreation

Current recreation uses observed and managed within the project area include but are not limited to, hiking, permitted big-game hunting and recreation events, wildlife viewing, viewing nature, and photography. The entire project area is located within the boundary of Restricted Area #3, which prohibits off trail travel, camping, campfire, pets, bicycles, and horses (see attached Special Closure Area). Recreational access to the project area is limited to foot traffic (hikers and pedestrians). Visitor management is limited to trail signage (directional and confidence markers) as well as minor interpretive/regulatory information.

ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION AND ALTERNATIVES

This section displays the potential impacts of the proposed action and alternative. By comparing potential impacts of each proposal, the decision-maker and interested persons can assess the benefits of the alternatives, evaluate trade-offs posed by the environmental consequences, and determine if the relevant issues and concerns have been adequately addressed.

The National Environmental Policy Act defines cumulative effects as, the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (Council on Environmental Quality Regulations Section 1508.7).

Table 2. Projects Considered in the Cumulative Effects Analysis.

Action	Description	Date
	Past	
Pumping station construction and associated road access	Construction of a primitive road across the Pumice Plain to facilitate construction and operation of an emergency pumping station.	1982-1985

Maintenance of FSR 99 beyond Windy Ridge and developed parking lot	This road past Windy Ridge was maintained for researcher access. The project also included the establishment of a designated parking area for scientists and placement of large boulders to prevent motorized vehicles from traveling further out onto the Pumice Plain.	1989
Present and Ongoing		
Forest trails	Management of existing trails including erosion control work, route signing, and maintenance. Trails include the Boundary Trail and Truman Trail.	Ongoing
Forest roads	Regular maintenance including but not limited to grading, drainage maintenance and patching	Ongoing
Visitors to Johnston Ridge	Heavy seasonal, recreational use of the Boundary Trail to Devil's Bypass.	Ongoing
Crater View Hiking Route	Guided hikes are being offered on this hiking route.	Ongoing
Research	Research plots or studies occurring on the Pumice Plain	Ongoing
Future		
Coldwater Science and Learning Center Camp Sites	Scientist/volunteer campground to be developed in phases, adjacent to Coldwater SLC between SLC and housing.	Ongoing and over the next several years
Potential camping on Coldwater Lake	Planning is on hold until and unless there is partner interest	NA
Potential Kalama River camping sites	Planning is on hold until and unless there is partner interest	NA
Global climate change effects	Significant changes to atmospheric conditions that could affect vegetation, soil temperature and moisture regimes, increased temperatures and heavy precipitation events.	Already begun, more significant changes expected

Social/Recreation

Analysis Methods – Recreation Resources

Recreation Resources –Remoteness

Remoteness refers to the extent to which individuals perceive themselves removed from the sights and sounds of human activity.

Recreation Resources –Naturalness/Visuals

Refers to the degree of naturalness of the setting; it affects psychological outcomes associated with enjoying nature.

Recreation Resources –Visitor Management

This includes the degree to which visitors are regulated and controlled as well as the level of information and services provided for visitor enjoyment. In some settings, controls are expected and appropriate. For instance, people sometimes seek developed settings for security and safety. Elsewhere, on-site controls may detract from desired experiences, such as independence, self-reliance, and risk-taking.

The type and level of information, and where it is provided to the visitor, may facilitate or hinder a desired experience. On-site interpretive and directional signing may adversely affect the visitor where experiences such as self-discovery, challenge, and risk are important. In other situations, on-site information may be essential to achieve desired experiences.

No Action

Direct, Indirect and Cumulative Effects

No new actions would be authorized under the no action. Recreational use would likely continue with little to no effect on how visitors experience remoteness, naturalness or visitor management.

Proposed Action

Direct and Indirect Effects

Recreation Resources –Remoteness

This action could have temporary effects on recreational user's perspective of being removed from the sights and sound of human activity. The presence of machinery and workers during the construction, reconstruction, and maintenance of the access route as well as drilling activities could have a negative effect on visitor's experience.

Recreation Resources –Naturalness/Visuals

The presence of machinery and workers during the construction, reconstruction, and maintenance of the access route as well as drilling activities could temporarily have a negative effect on recreational visitor experience by reducing the naturalness and visuals of the area. It will be important to provide up to date and accurate information at the trailheads describing the

purpose of the work, what to expect while hiking the trail, and list alternate areas the recreate that will provide similar experiences.

Under this alternative the old roadbed which now serves as the Truman trail would be reclaimed to a width of 8 feet in order to accomplish drilling operations and tunnel maintenance. The Truman Trail is currently managed and maintained as a hiker/pedestrian Trail Class 2 (moderate development). Typically class 2 trails have continuous and discernable but narrow and rough tread, constructed features are of a limited size, scale, and quality, route identification signs are limited to junctions, and provide for a natural and essentially unmodified recreation experience. Even though evidence of the old road bed exists (old cut banks, etc.) most of the trail meets the management objectives of a trail class 2 and provides a natural and relatively unmodified recreation experience. The improvement of the road will alter the visual and naturalness of the area to a higher class of modified experience often associated with more developed trail classes. Once drilling operations are completed it is assumed that the route will be allowed to naturally narrow in width and then be maintained at 60-65". This will still allow for administrative motorized access to the tunnel via UTV while providing a more trail like experience for recreational users. Ultimately, the Truman Trail may need to be reclassified as a trail class 3 or 4 to meet required maintenance objectives in order to provide safe administrative motorized access to the tunnel.

Recreation Resources –Visitor Management

Visitor management activities including signage and on-site controls would increase under this alternative.

The physical and visual presence of a developed route to the shores of Spirit Lake will likely increase the number of recreational users that choose to leave the designated trail and visit the lake. Placing regulatory signage stating "authorized access only" and interpretive signage explaining the purpose of the motorized administrative route, why it is needed, the fragility of the area and its continued status as an "on-trail only area" with no camping or access to Spirit Lake for fishing or recreating will need to be placed where the administrative motorized route departs from the trail as well as other likely areas where recreationalists might try to travel cross country to access the route.

Temporary trail closures to provide for health and safety during construction, reconstruction, and maintenance activities of the route or portions of the route may be required. Trail closures would need to be posted on the Gifford Pinchot website and at trailheads that provide access to the area. Enforcement personnel would need to be present during working hours to ensure that there is no unauthorized access to work areas.

Cumulative Effects

For the purposes of this analysis the cumulative effects area for the recreation analysis is the boundaries of the project area. Cumulatively, the effects of the proposed action will not likely have a long-term adverse effect to monument visitors accessing the area, or in the recreational experience they seek when coming to or travelling through the area and therefore no cumulative effects. Increased patrols in the area during and after the action as well as maintenance of additional interpretive and regulatory signage will need to be considered in future budgeting and

personnel needs. While the perceived remoteness, naturalness, and amount and type of visitor management may be affected in the short-term while work is occurring or when authorized individuals are utilizing the routes by approved means, this will not have an adverse effect far into the future and no other activities such as ongoing trail maintenance will have a negative cumulative effect.

Alternative 1. West Access –JRO to South Shore Spirit Lake

Direct and Indirect Effects

Recreation Resources –Remoteness

A motorized administrative access route could have temporary effects on recreational user's perspective of being removed from the sights and sound of human activity. The presence of machinery and workers during the construction, reconstruction, and maintenance of the access route as well as noise and visual impact of drill rigs could have a negative effect on visitor's experience.

Recreation Resources –Naturalness/Visuals

The Boundary Trail east of the Johnston Ridge Observatory parking area offers expansive views of the volcano crater as well as the Pumice Plains and receives heavy recreational traffic to Devil's Elbow which is a popular destination and turn around point for visitors. The drilling area is visible from multiple points along the Boundary and Truman trails as well as the Devil's Elbow overlook. The presence of machinery and workers as well as noise associated with the drill rigs could have temporary negative effect on visitor's experience.

Under this alternative the Boundary Trail east of Johnston Ridge Observatory as well as a portion of the Truman trail would be widened to a width of up to 8 feet in order to accomplish drilling operations and/or tunnel maintenance. The Boundary Trail is currently managed and maintained as a hiker/pedestrian Trail Class 3 (developed). Typically, class 3 trails have continuous and obvious tread, trail structures (walls, steps, improved drainage, raised trail) are common and can be substantial, route identification signs at junctions and as needed for user reassurance, and provides for a natural and primarily unmodified recreation experience. At this time the Boundary Trail meets the standards for a trail class 3. The improvement of the trail to a motorized route may alter the visual and naturalness of the area to a higher class of modified experience often associated with more developed trail classes. Once drilling operations are completed it is assumed that the route will be allowed to naturally narrow in width and then be maintained at 60-65". This will still allow for administrative motorized access to the tunnel via UTV while providing a more trail like experience for recreational users. Ultimately, the

Boundary trail may could remain a trail class 3 but it could also be reclassified as a trail class 4 to meet required maintenance objectives in order to provide safe administrative motorized access to the tunnel. The improvements required on the Truman Trail would probably require it to be reclassified as a trail class 3 or 4,

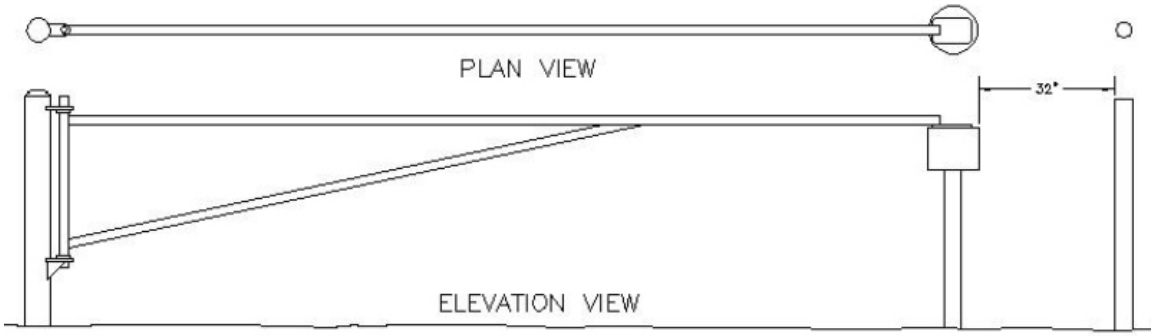
Recreation Resources –Visitor Management

A need for visitor management activities including signage and on-site controls would increase under this alternative.

The physical and visual presence of a developed route to the shores of Spirit Lake will likely increase the number of recreational users that choose to leave the designated trail and visit the lake. Placing regulatory signage stating "authorized access only" and interpretive signage explaining the purpose of the motorized administrative route, why it is needed, the fragility of the area and its continued status as an "on-trail only area" with no camping or access to Spirit Lake for fishing or recreating will need to be placed where the administrative motorized route departs from the trail as well as other likely areas where recreationalists might try to travel cross country to access the route.

Temporary trail closures to provide for health and safety during construction, reconstruction, and maintenance activities of the route or portions of the route may be required. Trail closures would need to be posted on the Gifford Pinchot website and at trailheads that provide access to the area. Enforcement personnel would need to be present during working hours to ensure that there is no unauthorized access to work areas.

In order to prevent unauthorized motorized access on the route a gate like the one depicted below would need to be installed at the beginning of the access route. Depending on where the route begins, an accessible walk-through might also be required to facilitate pedestrian and wheelchair access beyond the gate. Appropriate signage would need to be attached or placed adjacent to the gate in order to discourage unauthorized motorized use and other unauthorized uses (bike and horse). Once drilling is completed, and there is no further need for full size vehicle access the gate could be removed and replaced with bollards spaced so as to allow authorized motorized access via UTV in order to reduce the likelihood of vandalism to the gate. Removing the gate may increase the likelihood of motorized trespass by motorcycles and UTVs.



Cumulative Effects

For the purposes of this analysis the cumulative effects area for the recreation analysis is the boundaries of the project area. Cumulatively, the effects of the proposed action with ongoing trail maintenance will not likely have a long-term adverse effect to monument visitors accessing the area, or in the recreational experience they seek when coming to or travelling through the area. Increased patrols in the area during and after the action as well as maintenance of additional interpretive and regulatory signage will need to be considered in future budgeting and personnel needs. While the perceived remoteness, naturalness, and amount and type of visitor management may be affected in

the short-term while work is occurring or when authorized individuals are utilizing the routes by approved means, this will not have an adverse effect far into the future.

Alternative 2. – East Access from FSR 99 Along Windy Ridge to Duck Bay

Direct and Indirect Effects

The activities that are the same as the proposed action are described in that section. Only actions unique to Alternative 2 are described here.

Recreation Resources –Remoteness

Drilling Equipment Access

The use of helicopters to transport equipment could have temporary effects on recreational user's perspective of being removed from the sights and sounds of human activity.

Long-term UTV Access

Effects to remoteness would be limited under this alternative because the motorized access route would no longer utilize the Truman Trail. The trail would remain as it is currently designated as a Class 2 trail and provide for a natural and essentially unmodified recreation experience. Increased utilization of the researchers parking area as well as the sounds of motorized vehicles utilizing or maintain the route could have negative effects on visitor's experience in and around the end of FR 99 extension, but remoteness would ultimately be maintained across the Pumice Plain.

Recreation Resources –Naturalness/Visuals

Drilling Equipment Access

The dropping off and picking up of sling loads by helicopters could have a temporary negative effect on recreational visitors experience by reducing the naturalness and visuals of the area. This effect would be limited to a number of days rather than weeks or months that would be needed to improve the Truman Trail into a motorized access route. Ultimately, the trail would remain classified as hiker/pedestrian and provide for the much less developed trail experience hikers expect on the Monument.

Long-term UTV Access

The topography of Forsyth Creek and surrounding landscape will effectively obscure nearly the complete length of the proposed motorized access route from viewpoints across the Monument. However, the route terminates just below Windy Ridge Interpretive Site meaning that vehicles, equipment, and people utilizing this route will be visible from this popular recreation area. Evidence of human activity may temporarily effect visitor visuals at Windy Ridge and perhaps cause confusion in regards to the special closure area.

The Truman Trail parallels Forsyth Creek for approximately half a mile before the trail cuts north while the trail continues to the northwest. Hikers along the trail may be able to look into the drainage and observe vehicles or maintenance equipment and this may have temporary effects on the naturalness or visuals or the area.

Recreation Resources –Visitor Management
Drilling Equipment access

Temporary trail closures would not be needed because no official trails would be impacted under this alternative. Signage at both ends of the trail would be placed to warn of helicopter activity and reminding visitors to stay on designated trails.

Long-term UTV Access
Placing regulatory signage stating "authorized access only" and interpretive signage explaining the purpose of the motorized administrative route, why it is needed, the fragility of the area and its continued status as an "on-trail only area" with no camping or access to Spirit Lake for fishing or recreating will need to be placed where the administrative motorized route departs from the researchers parking area. Additional signage and information will need to be provided at Windy Ridge reinforcing that Spirit Lake is open to authorized access only. Interpretive rangers should be stationed at Windy Ridge on days the route is expected to see use in order to educate and inform visitors about the need and purpose of the activity.

Cumulative Effects
For the purposes of this analysis the cumulative effects area for the recreation analysis is the boundaries of the project area. Cumulatively, the effects of the proposed action together with ongoing recreational use and trail maintenance will not likely have a long-term adverse effect to monument visitors accessing the area, or in the recreational experience they seek when coming to or travelling through the area. Increased patrols in the area during and after the action as well as maintenance of additional interpretive and regulatory signage will need to be considered in future budgeting and personnel needs. While the perceived remoteness, naturalness, and amount and type of visitor management may be affected in the short-term while work is occurring or when authorized individuals are utilizing the routes by approved means, this will not have an adverse effect far into the future.

Research

No Action

Direct and Indirect Effects
No new actions would be authorized under the no action. Ongoing research would likely continue. Research conducted by USGS and other research organizations generally involve non-motorized ground access (hiking) by personnel supported by helicopters for transport of personnel, supplies and equipment as needed. Many researchers access the Pumice Plain via Forest Road 99 past Windy Ridge to the so called "Scientists' Parking Lot."

Cumulative Effects
There would be no cumulative effects associated with No Action.

Effects Common to All Action Alternatives

Effects to Research from Surface Erosion and Sediment Deposition

The Pumice Plain and volcanic crater that feeds its small streams is a geologically active area. The Pumice Plain and Spirit Lake shoreline are subject to considerable scouring and deposition of sediment from volcanic activity, large flood events, spring run-off and wind erosion and deposition.

It is clear that impacts resulting from ATV and UTV use would likely be substantially smaller in scale than what occurs during periods of volcanic activity and elevated runoff and streamflow from storms and rain on snow events. What is hard to assess is the effect of smaller, but more frequent ground disturbance and introduction of sediment associated with motorized ATV and UTV passage. The magnitude of such impacts will likely vary depending on the nature of the terrain crossed, the methods employed by ATV and UTV operators to minimize disturbance, and the frequency, duration and total number of motorized trips.

Effects to Research from Invasive Species

Wheeled or tracked equipment has the potential to be a vector of introduced noxious weeds and invasive species both from materials transported to the Pumice Plain from off-site and from the transport and redistribution of materials picked up on the Pumice Plain. Prevention measures included in the project design should lessen the likelihood of introduction and spread.

Effects to Research from Alteration of Public Access

The incidence of off-trail travel in the CMP designated Class I Research Area (Pumice Plain and Spirit Lake basin) is currently limited by the remote nature of the site and the fact that visitors are encouraged by rough off-trail conditions to remain on the trail. Current compliance benefits from the fact that the trail is the easiest travel route and best defined path through patchy but dense brushy vegetation and the uneven rocky terrain.

It is possible that the widening and improving of existing trails and establishment of new motorized access routes will result in more people hiking in the Pumice Plain and Spirit Lake basin. Such trespass is already occurring and is likely to increase along a more visible pathway given the very limited on-site presence, signing, and staff resources available to administer management of the Pumice Plain and Spirit Lake basin. The possibility of invasive aquatic species being introduced to Spirit Lake by recreationists and anglers is of particular concern to scientists as the introduction of aquatic invasive species could alter the natural system and negatively impact long-term research at Spirit Lake.

Proposed Action

Direct and Indirect Effects

Summary of effects to research

A substantial community of researchers have shown the value of Mount St. Helens to science, with Mount St. Helens being the most studied of all volcanoes on the globe in terms of ecosystem responses to eruptions. The proposed north access route crosses ground that is particularly vital and valuable for long-term terrestrial and aquatic ecological research. (Swanson, F., Pers. Letter, 2017). Of particular concern to many scientists and citizens are how actions would compromise past and current research, as well as future research opportunities, which are considered one of the primary missions of the Monument (Crisafulli, Pers. Letter, 2017).

Disturbance to existing research studies was identified early on as a preliminary conflict with the proposed action. Ground disturbance associated with the motorized route and path down Willow Springs could directly harm research plots from increased sedimentation, compaction or alteration of stream flow on or near the plots. Other indirect effects could also occur such as noise and dust associated with the use of motorized equipment, spread of invasive plants and alteration of recreational use in the area.

Though efforts were made to determine the location of ongoing research plots and sampling sites during the planning process, there may be additional research ongoing in the project area. From what is known, there are 33 active research studies on the Pumice Plain. Most of the studies have numerous plots or are associated with long transects, cumulatively dotting the landscape with hundreds of data points. The majority of plots occur outside of the route and drilling locations. And most of the remaining sites that overlap with the project should only incur short-term impacts during implementation or for many of the studies be avoided altogether by working closely with the PNW Research Station and affected researchers. Most of the direct impacts to research plots and sample sites would likely occur within 25 to 50 meters of the access route due to clearing and widening where the route crosses steep slopes and route reconstruction and repair associated with stream or wetland crossings.

Studies in or along the mapped access route that can likely be avoided include an herbivory survey study; a small mammal ecology study; a terrestrial micrometeorology study; an avian ecology study; soil studies, including mycorrhiza ecology and soil-tephra-physical-chemistry; invertebrate studies, including terrestrial arthropod ecology, and amphibian studies.

The studies that are the most likely to experience interference from the drilling equipment and route construction include a group of plant studies (in places where rerouting cannot avoid the vegetation) and multiple aquatic studies focused on stream species, temperature and water chemistry, and those concentrated on the biological, chemical and physical make-up of Spirit Lake. It is anticipated that effects from sedimentation created during route construction would alter the systems under study, and could have the greatest impact, at least in the short term.

Mitigation is included to reduce these impacts such as working closely with PNW scientists during implementation (perhaps even moving the path slightly) to avoid or buffer research sites. Sensitive features and research plots will be clearly designated and marked and clear expectations will be developed with standards for operators to follow to avoid sensitive areas and minimize disturbance.

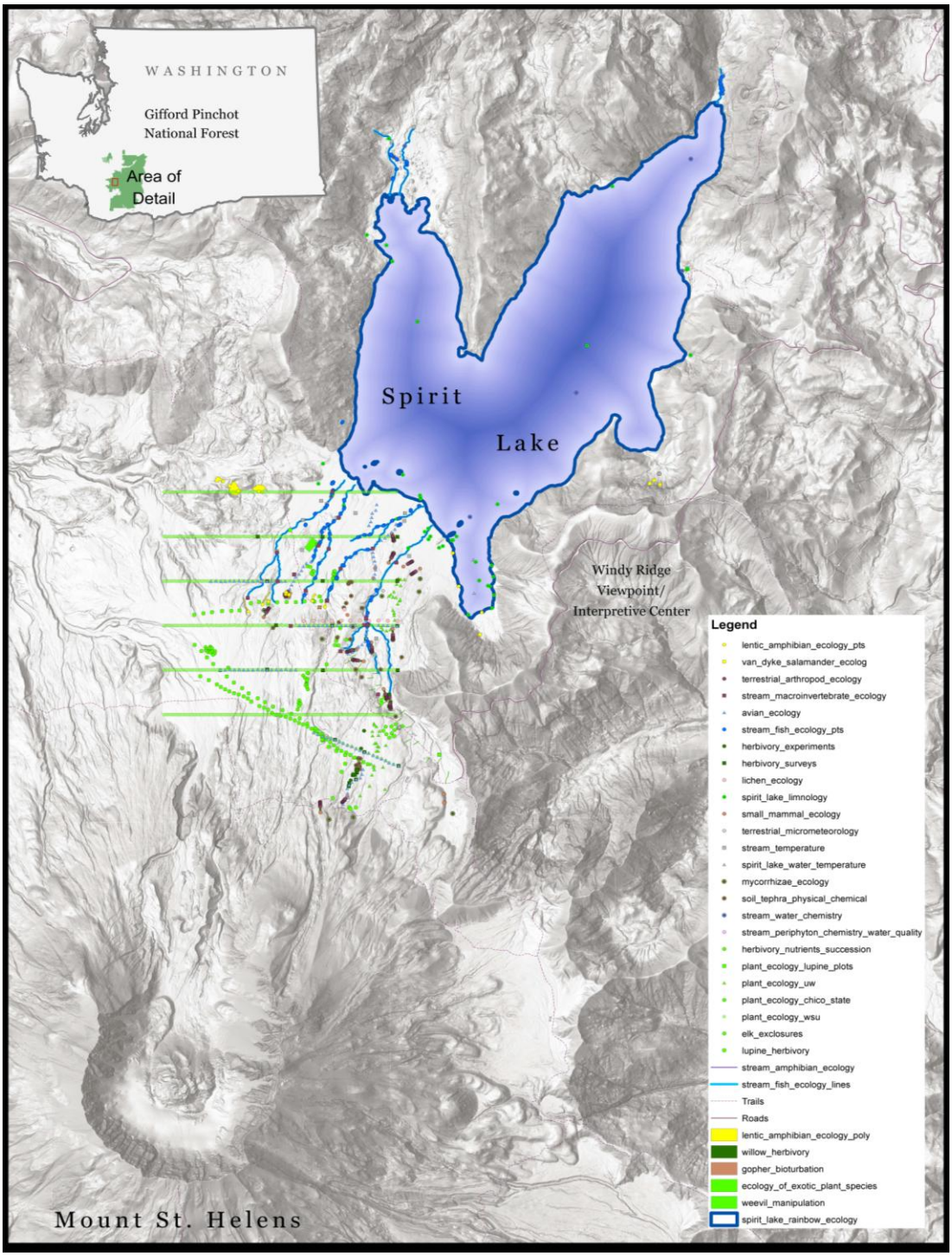


Figure 30. Map showing ongoing biological research studies (Courtesy of Charlie Crisafulli, US Forest Service PNW Research Station).

It is clear that the quantity of sediment and magnitude of downstream impacts will be substantially lower than those associated with debris flows and mudflows resulting from infrequent volcanic activity and high stream flows and surface runoff resulting from winter storms and rain-on-snow events. That said, the impacts from construction and maintenance will likely be different because they will occur during lower flow periods in the June through September operating season.

Impacts to Ongoing Research in Wetlands, Streams and Aquatic Studies in Spirit Lake

Impacts to research associated with motorized access for the proposed action would be influenced by the total number of stream and wetland crossings and the level of construction and ongoing maintenance required for each crossing. In this respect, the type of equipment involved, period and duration of access, and amount of regrading and channel alteration required will greatly influence the potential impacts to research resulting from the disruption of stream flow and increased sedimentation and input of dissolved nutrients (see Hydrology section). Impacts will be directly related to the size of drilling, UTV and construction equipment used and the frequency of stream and wetland crossings.

The largest potential impacts to aquatic studies and associated biota would likely result from the use of rock fills, if utilized during implementation, to armor stream and wetland crossings. This could also likely further alter the natural flow regime, change patterns of erosion and deposition of sediments and, potentially result in the deposition of large cobbles and sediment downstream during future high flow events. As such no import of material will be allowed for this project and no fill will be used in stream channels. Research studies of both aquatic systems and associated biota could also be impacted by the comparatively small but more frequent input of sediment and nutrients resulting from the repeated passage of UTVs and ATVs over small streams, seeps, and springs.

Impacts to Terrestrial Research

The upland portions of the route cross some of the last intact 1980 pyroclastic flow deposits (not reworked by erosion or streams) available on the Pumice Plain. It is expected that the potential impact to terrestrial vegetation studies will generally be confined to research plots within 25 meters of the motorized access route. In this respect, the route across the Pumice Plain has the potential to directly or indirectly impact nine aquatic and 72 terrestrial research sites located within 25 meters and to a lesser extent 16 aquatic and 70 terrestrial sample plots located between 26 and 50 meters of the route. (These numbers include some duplication as some streams and research polygons intersect both the 0-25 and 26-50 meter buffer). Another 11 aquatic and 15 terrestrial research sites located within 25 meters and one aquatic and nine terrestrial sample plots located between 26 and 50 meters could be directly impacted by the UTV route down Willow Springs.

Cumulative Effects

The cumulative effects area is the area in and around the Pumice Plain where ongoing research is occurring. Projects that may be contributing to cumulative impacts to research include past effects from the existing roadbed, trail use and maintenance of the Truman Trail and Boundary Trail, guided hikes to the Crater View, recreational trespass for hiking to or fishing from Spirit Lake. While these activities do have the potential to produce sediment, erosion or weed

introduction, their contribution to cumulative effects is likely minimal compared to the proposed action.

Alternative 1. West Access –JRO to South Shore Spirit Lake

Direct and Indirect Effects

This alternative which provides access to the south shore of Spirit Lake through a route that is mostly outside of the Spirit Lake basin would reduce the level of disturbance to most of the Pumice Plain. This route would result in much fewer stream crossings and activities associated with maintenance of the route in stream crossings.

Impacts to Ongoing Research in Wetlands and Fish and Nutrient Studies in Spirit Lake

Access to the SW corner of the lake may be challenging and boat navigability difficult. The most direct access would likely be along the lake shoreline which would be limited by large logs, multiple small streams, seeps and unstable marshy areas. It should be noted that extended periods of tunnel closure in the future would result in elevated lake levels which could redistribute the large stranded logs on the shoreline resulting in blockage of any newly developed lakeshore access route. This could complicate the construction and maintenance of a motorized access route to the boat launch area from the SW lakeshore.

Impacts to research from motorized access along the lakeshore could result in direct and indirect impacts to terrestrial and aquatic organisms both from the addition of increased sedimentation and nutrients to wetlands and areas of the lake fed by groundwater springs and tributary streams. Research studies both on the shoreline and in the lake could be impacted by sediment and nutrients mobilized by the passage of ATVs and UTVs over small streams, seeps, and springs. The addition of rock fills, if utilized, to stream crossings would likely alter the natural flow regime of the stream and alter patterns of erosion and deposition of stream delta sediments. It could also result in the deposition of large cobbles and sediment downstream during high flow events. As such no import of material will be allowed for this project and no fill will be used in stream channels.

Disturbance to the Debris Avalanche Spillover Deposit

An important impact of the construction of a motorized access route from the Johnston Ridge Observatory would be disturbance to the debris avalanche (spillover) deposits associated with the run-up and overtopping of Johnston Ridge by the 1980 debris avalanche. The need for switchbacks and construction of full bench cuts and fills will also increase the impacts to the geologically important deposits and associated research on interactions between the 1980 pyroclastic density current (PDC or lateral blast), pre-eruption topography and the debris avalanche (landslide) and how they influenced the PDC's speed, duration and resulting hazard zone (Brittany Brand, Boise State University and colleagues). An additional impact would likely result from crossing the highly erodible, fine-grained pyroclastic surge deposits that cap the debris avalanche deposit. Disturbance of these fine-grained deposits could result in disturbance to this geologically important PDC feature and additional sediment flowing onto the Pumice Plain and into Spirit Lake as a result of construction and maintenance activities.

Potential for Damage from Snowmobiles Resulting from Increased Winter Trespass

Construction of a topographically accessible motorized travel route along Johnston Ridge and down the spillover deposit could increase the potential for snowmobiles to trespass into the Spirit Lake basin using the constructed west side access route. Snowmobiles are already entering closed areas of the Monument from State Route 504 during periods when State Route 504 is closed by snow and USFS staff are not present. Research documenting the impacts of tracked snow machine use in recreation areas indicates that such use alters both the insulating properties and duration of the snowpack. The resulting compaction reduces the thermal insulation of the snow and, therefore, its protection of the underlying biota. It also results in a change in the duration of snow cover. Additional impacts occur when snowmobiles drive over areas of low snow depth resulting in physical tracking of the surface and the breakage of small trees and shrubs. It should be noted that the distribution and depth of snowpack in the 1980 blast zone and on the Pumice Plains is quite variable due to lack of vegetative cover and redistribution of the snowpack by wind, so it is difficult for skiers, snowshoers and other recreationists to tell when they are crossing deep vs thinly snow-covered areas.

Cumulative Effects

The cumulative effects area is the area in and around the Pumice Plain where ongoing research is occurring. Projects that may be contributing to cumulative impacts to research include past effects from the existing roadbed, trail use and maintenance of the Truman Trail and Boundary Trail, guided hikes to the Crater View, recreational trespass for hiking to or fishing from Spirit Lake. While these activities do have the potential to produce sediment, erosion or weed introduction, their contribution to cumulative effects is likely minimal comparted to Alternative 1.

Alternative 2. – East Access from FSR 99 Along Windy Ridge to Duck Bay

Direct and Indirect Effects

The activities that are the same as the proposed action are described in that section. Only actions unique to Alternative 2 are described here.

Utilizing the route to Duck Bay as a first attempt to provide long-term UTV access which sharply reduce the number of research plots that would be directly or indirectly affected by the Alternative. Only one research site is known in this area and could potentially be directly or indirectly impacted. If the Duck Bay route cannot be maintained in the long term and a route down Windy Ridge is utilized, effects to research would be the same as the proposed action.

Cumulative Effects

The cumulative effects area is the area in and around the Pumice Plain where ongoing research is occurring. Projects that may be contributing to cumulative impacts to research include past effects from the existing roadbed, trail use and maintenance of the Truman Trail and Boundary Trail, guided hikes to the Crater View, recreational trespass for hiking to or fishing from Spirit Lake. While these activities do have the potential to produce sediment, erosion or weed introduction, their contribution to cumulative effects is likely minimal comparted to Alternative 2.

Botanical Species

A botanical resource report was completed as part of this analysis and the full report can be found in the project file.

A review of current information was performed to determine whether project activities pose a potential threat to the Regional Forester's Threatened, Endangered, Proposed, or Sensitive (TESP) species and other botanical resources. This review consists of an analysis of potential effects of the project on known sites of species of concern or their potential habitat. The 2015 Regional Forester's Sensitive Plant list (USDA Forest Service 2015), GIS information, published sources and the NRIS – TES database (2017) were consulted for the review. Additionally, Charlie Crisafulli (USFS, PNW Research Station) was contacted to search the existing plant database for the Pumice Plain research area.

A list of TEPS and S&M species and their likelihood of occurrence in the planning area can be found in Appendix A to the Botanical Resource Report.

The botanical survey for the proposed road access route was conducted on June 8th 2017. Surveys were conducted for sensitive plant species based on the Regional Forester's 2015 list (USDA Forest Service 2015). The survey for Survey and Manage species was conducted at the same time.

Due to differing plant phenology and life stages required for plant identification, species identification is not always possible with a one-time survey. However, knowledge of plant-habitat relationships, vegetative identification, and flowering dates assists the surveyor with identification.

This analysis utilized the existing plant database, which is maintained for active plant succession research in the project area, to determine that one sensitive species (*Montia diffusa*) and no Survey and Manage Species have been documented in research plots on the Pumice Plain.

The survey began at the Johnston Ridge Observatory, and followed the alternative access route to the Pumice Plain and the intersection with the Willow Springs Channel. The proposed action trailhead was inaccessible due to snow at the time of the field visit.

No Action

Direct and Indirect Effects

Federally-listed Species

Under the no action alternative there would be no potential for disturbance to federally listed species because no suitable habitat exists in the project area. Therefore, there would be **no impacts** to federally-listed species.

Forest Service Sensitive Species

Although one sensitive species has been documented on the Pumice Plain (*Montia diffusa*), the no action alternative would not subject this species any new disturbance. Continuation of current activities on the Pumice Plain (recreational trail use and ongoing research activities) would cause **no impact** to sensitive species.

Survey and Manage Species

No Survey and Manage species were located within the proposed road access route or are known to occur in the project area.

Cumulative Effects

There would be no cumulative effects under the no action alternative.

Proposed Action

Direct and Indirect Effects

Federally-listed Species

No botanical species that are federally listed as threatened, endangered, or proposed were detected during surveys of the project area. Only one federally-listed plant species (*Howellia aquatilis*) is suspected to occur in the forest. However, the species has extremely narrow habitat tolerance, and its likelihood of occurrence in the project area is almost non-existent. Water *howellia* can be found in ephemeral glacial ponds and former river oxbows that fill with spring moisture and dry down throughout the growing season. *Howellia* is also limited by specific requirements for seed germination. Seed germinates in the fall when a pond has dried and the bottom is exposed to the air. These conditions do not exist on the Pumice Plain. Therefore, the proposed action would have no effect on federally-listed botanical species.

Forest Service Sensitive Species

No Regional Forester's Sensitive species were located during field surveys in the project area. However, branching montia (*Montia diffusa*) has been documented in research plots on the Pumice Plain. This is a low, spreading, succulent, branched annual, typically found in moist forests and open fir woodlands in the lowland and lower montane zones. However, it is occasionally found in xeric soil or disturbed sites. Due to this species annual life history and potential for growth in disturbed sites, it could disperse into the project area, despite no detection during the field survey. Due to this potential, the proposed action **may impact individuals or habitat but will not likely contribute to a trend towards Federal listing or a loss of viability to the population or species**. See the Design Features and Best Management Practices section to ensure this effects determination will be met.

Survey and Manage Species

No Survey and Manage species were located within the proposed road access route or are known to occur in the project area.

Cumulative Effects
There are no cumulative effects on threatened, endangered, or proposed botanical species because there are no direct or indirect effects. No other projects on the Pumice Plain (trail maintenance and researcher access) would change the impact determination to the *Montia diffusa*.

Alternative 1. West Access –JRO to South Shore Spirit Lake
Direct and Indirect Effects

Federally-listed Species

No botanical species that are federally listed as threatened, endangered, or proposed were detected during surveys of the project area. Only one federally-listed plant species (*Howellia aquatilis*) is suspected to occur in the forest. However, the species has extremely narrow habitat tolerance, and its likelihood of occurrence in the project area is almost non-existent. Therefore, the alternative would have no effect on federally-listed botanical species.

Forest Service Sensitive Species

No Regional Forester's Sensitive species were located during field surveys in the project area. However, branching montia (*Montia diffusa*) has been documented in research plots on the Pumice Plain. This is a low, spreading, succulent, branched annual, typically found in moist forests and open fir woodlands in the lowland and lower montane zones. However, it is occasionally found in xeric soil or disturbed sites. Due to this species annual life history and potential for growth in disturbed sites, it could disperse into the project area, despite no detection during the field survey. Due to this potential, the alternative **may impact individuals or habitat but will not likely contribute to a trend towards Federal listing or a loss of viability to the population or species**. See the Design Features and Best Management Practices section to ensure this effects determination will be met.

Survey and Manage Species

No Survey and Manage species were located within the proposed road access route or are known to occur in the project area.

Cumulative Effects
There are no cumulative effects on threatened, endangered, or proposed botanical species because there are no direct or indirect effects. No other projects on the Pumice Plain (trail maintenance and researcher access) would change the impact determination to the *Montia diffusa*.

Alternative 2. – East Access from FSR 99 Along Windy Ridge to Duck Bay
Direct and Indirect Effects

Federally-listed Species

No botanical species that are federally listed as threatened, endangered, or proposed were detected during surveys of the project area. Only one federally-listed plant species (*Howellia*

aquatilis) is suspected to occur in the forest. However, the species has extremely narrow habitat tolerance, and its likelihood of occurrence in the project area is almost non-existent. Therefore, the alternative would have no effect on federally-listed botanical species.

Forest Service Sensitive Species

No Regional Forester's Sensitive species were located during field surveys in the project area. However, branching montia (*Montia diffusa*) has been documented in research plots on the Pumice Plain. This is a low, spreading, succulent, branched annual, typically found in moist forests and open fir woodlands in the lowland and lower montane zones. However, it is occasionally found in xeric soil or disturbed sites. Due to this species annual life history and potential for growth in disturbed sites, it could disperse into the project area, despite no detection during the field survey. Due to this potential, the alternative **may impact individuals or habitat but will not likely contribute to a trend towards Federal listing or a loss of viability to the population or species**. See the Design Features and Best Management Practices section to ensure this effects determination will be met.

Survey and Manage Species

No Survey and Manage species were located within the proposed road access route or are known to occur in the project area.

Cumulative Effects

There are no cumulative effects on threatened, endangered, or proposed botanical species because there are no direct or indirect effects. No other projects on the Pumice Plain (trail maintenance and researcher access) would change the impact determination to the *Montia diffusa*.

Noxious Weed and Invasive Non-Native Species

Species Present

Under the Proposed Action and Alternative 2, minimal ground disturbance would occur during trail construction. Under Alternative 1, more disturbance would be necessary, but it would be relatively contained in the route area.

Noxious weeds often thrive in early seral habitats, with life history traits that aid in rapid colonization of disturbed areas and available habitat niches. Invasive species, whether they are artificially introduced to a disturbed area or not, can play an influential role in early stage succession (Dale & Adams 2003). The addition of a motorized trail into early seral habitat like the Pumice Plain poses a risk to the current succession trajectory if proper prevention measures are not conducted. Non-native and invasive species persist in the project area and on the Pumice Plain (Table 1 in and Appendix B to the Botanical Resources Report). Therefore, the goal is not to eradicate all existing non-natives, but minimize the potential for the access route to contribute to growth of existing non-native populations and introduction of new non-natives that persist at each trailhead. In order to control noxious weed colonization and spread under the proposed and alternative actions, weed-spread prevention and treatment activities should be implemented before each use of the access route in combination with long-term monitoring and weed treatment along the route.

Of the three types of weed classifications in Washington State, Class A species are limited in distribution in Washington State, and State law requires that these weeds be eradicated. Class B weeds are either absent from or limited in distribution in some portions of the state but very abundant in other areas. The goals are to contain the plants where they are already widespread and prevent their spread into new areas. Class C weeds are known to be widespread in Washington State; counties can choose to enforce control, or they can educate residents about controlling these noxious weeds.

Due to the unique habitat in this project area, treatment of all non-native species not already present along the proposed access route and Pumice Plain should be the focus of treatments in the equipment staging areas, regardless of whether they are ranked by the state.

Noxious weeds and non-native species occur in higher abundance at the alternative 1 access trailhead than within the project area. These are the top priority for treatment at the equipment staging areas to minimize the potential for introductions.

Table 3. Invasive and non-native plant species known to occur in or near Spirit Lake access road project area.

SCIENTIFIC NAME	**CLASS**	**Location**	**COMMON NAME**	**Priority for Treatment**
Hieracium caespitosum	B	Throughout	Caespitose hawkweed	Moderate (in Alt. 1)
Hieracium pilosella	B	Throughout	Mouseear hawkweed	Moderate (in Proposed Action and Alt. 2)
Hypochaeris radicata	C	Throughout	Catsear	Moderate (in Proposed Action and Alt. 2)
Senecio jacobaea	B	Alternative 1 at trailhead	Tansy ragwort	High
Taraxacum officinale		Alternative 1 at trailhead	Common dandelion	High
Dactylis glomerata		Alternative 1 at trailhead	Orchard grass	High
Hypericum perforatum	C	Alternative 1 at trailhead	Common St. Johnswort	High
Chrysanthemum leucanthemum	C	Alternative 1 at trailhead	Oxeye daisy	High
Lotus croniculatus		Alternative 1 at trailhead	Birdsfoot trefoil	High
Plantago landeolata		Alternative 1 at trailhead	English plantain	High

See Appendix B of the Botanical Resource Report for a table of established non-native species present at the alternative 1 access trailhead, and on the Pumice Plain. These species should be monitored along the road to ensure the road is not leading to an increase in abundance. Additionally, Appendix C of the Botanical Resource Report lists invasive species that have been previously documented in the project area but were not detected in the field survey. This table also includes which species have been observed near the proposed access route and Alternative 2 trailhead/access road.

Risk Assessment

Non-native plants include those species introduced intentionally or unintentionally to areas where they do not naturally occur. In the Pacific Northwest, invasive non-native plants most often originate from Europe and Asia. Without associated natural predators and diseases that controlled these species in their native habitats, these species can cause problems where they were introduced. If a species no longer experiences the limiting factors it experienced in its native habitat, it may become invasive, dominating the site and altering ecosystem balance. The undesirable results may include changes in biodiversity, fire frequency, soil erosion and hydrology of a site. Other effects include reducing the quality of recreational experiences, and altering the trajectory of succession.

Forest Service Manual directs that risk assessments for noxious weed and invasive plant establishment and spread be prepared as a part of project planning, with project design features recommended to reduce risk (FSM 2900, 12-5-11). In addition, the Pacific Northwest Region Invasive Plant Program Record of Decision for Preventing and Managing Invasive Plants (USDA 2005) provides invasive plant prevention and treatment/restoration standards and direction on all National Forest Lands within Region 6. This project (both the proposed action and both alternatives) have a high risk rating. Prevention measures are included to reduce this risk.

Wildlife Species

Alternative A – No Action

Direct and Indirect Effects

Federally-listed or Proposed Species

Gray Wolf
In the no action, there would be no potential for further disturbance to gray wolf to occur as a result of the development of the proposed access routes, and therefore **no effect** to gray wolf.

Wolverine
In the no action, there would be no potential for further disturbance to wolverine to occur as a result of the development of the proposed access routes, and therefore **no effect** to wolverine.

Sensitive and Survey & Manage Species

Mountain Goat
In the no action, there would be no potential for further disturbance to mountain goats to occur as a result of the development of the proposed access routes, and therefore **no impact** to mountain goats.

Van Dyke's Salamander
The sensitive and survey & manage mollusk species on the Gifford Pinchot National Forest are in general associated with either late-successional forest, mature hardwood or legacy feature dead wood habitat that is not present at.the proposed project sites. The no action would have **no impact** to the Van Dyke's salamander because no suitable habitat would be impacted.

Management Indicator Species

In the no action, there would be no potential for further disturbance to management indicator species to occur as a result of the development of the proposed access routes, and therefore **no impacts** to any management indicator species.

Neotropical Migratory Birds

In the No Action Alternative, there would be no potential for further disturbance to neotropical migratory bird habitat or ground nesting species to occur as a result of the development of the proposed access routes, and therefore **no impacts**.

Cumulative Effects
There would be no cumulative effects under the no action.

Proposed Action

Direct and Indirect Effects

Federally-listed or Proposed Species

Gray Wolf
The proposed action is located in potential habitat for gray wolf. The access route and drilling activity would be an increase in human activity in a relatively remote and roadless area on the Monument. At this point in time there is no known occupancy by wolves, but given the gradual increase in population in Washington and Oregon it is likely that in the future wolves could re-colonize the lands around Mt. St. Helens. The Monument's elk herd would provide an abundant source of prey for wolves if they were present.

Because there are no known occurrences of wolves and because the project will only minimally alter habitat and constitute a slight increase in disturbance from human activity and minimally affect the prey base, it is expected there will be **no effect** to gray wolf as a result of implementing the proposed action. If wolves were to occupy the Monument there are thousands of acres of

undeveloped land on the 110,000 acre Monument where human presence is minimal so they could easily avoid the disturbance from human activity from the proposed action.

Wolverine
Wolverines are associated with montane environments and sub-alpine habitat in Washington and also typically avoid areas of high human use. The habitat in the vicinity of the access route and drilling operations is not sub-alpine with elevations ranging from approximately 3,500 to 4,000 feet at the action areas. More suitable wolverine habitat occurs approximately 5 miles to the north of the project areas in the Mt Margaret Backcountry.

No wolverines have been documented recently on the Monument though it is possible they could be present without being detected. The have been detected on wildlife cameras near Mt. Adams, which is well within their home range.

The proposed action is not going to alter the habitat to any substantial extent to have any effect on wolverines which have large home ranges of hundreds of square miles. The proposed access route and drilling operations would be an increase in human disturbance on the monument but there is a minimal probability that the increase in use would disturb or cause habitat avoidance by wolverines. Therefore it is expected that there will be **no effect** to wolverine as a result of development of the proposed access route and drilling operations.

Sensitive and Survey & Manage Species

Mountain Goat
Mountain goat numbers on the Monument have seen a steady increase in recent years and currently there are an estimated 150 goats. The proposed action includes the potential for blasting which would likely disturb mountain goats. The geotechnical drilling also may incorporate the use of contained explosive charges that would likely disturb mountain goats as well and may cause them to avoid habitat in the vicinity of the drilling operations. In addition the development of the access route and the use of motorized vehicles would have the potential to impact mountain goats and also disturb habitat at the stream crossings. Therefore the determination for mountain goats as a result of implementing the proposed action is **may impact individuals or habitat but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.**

Van Dyke's Salamander
Van Dyke's Salamanders are dependent upon cool, moist environments, and are considered semi-aquatic because most locations are associated with streams or seeps. In the project area, their habitat is in seeps and the splash zone in headwaters and ridges and not in the streams on the Pumice Plain (personal communication, Charles Crisafulli). Pre-disturbance surveys under Survey and Manage (2001 ROD) are not required because the project area is not considered habitat.

Van Dyke's Salamander habitat does not occur in the project area. Thus, the proposed action would have **no impact** to Van Dyke's salamanders because no suitable habitat would be impacted.

Management Indicator Species

The following species are listed as Management Indicator Species for the Gifford Pinchot National Forest:

- Spotted owl – Represents species requiring mature and old-growth forest.
- Pine marten, pileated woodpecker – Represents species requiring mature and old-growth forest.
- Cavity excavators – Represents species requiring snags and down logs.
- Wood duck – Represents species requiring mature and old-growth deciduous riparian habitat.
- Goldeneye – Represents species requiring mature and old-growth coniferous habitat.
- Deer and Elk
- Mountain goat

Many of the Management Indicator Species, such as the northern spotted owl, pine marten and pileated woodpecker are associated with older forest structure and large snags which do not exist on the Monument where the proposed new access routes are; thus there isn't suitable habitat and no project impacts to these species. Pileated woodpeckers are listed as present on the Pumice Plain, but are probably using habitat there for foraging. Habitat for wood ducks and goldeneye ducks would not be affected by the proposed access routes. Impacts to mountain goats are discussed in the previous section. The development of the proposed access routes will have no impacts to cavity excavator species because suitable habitat for these species is largely absent and the project would not alter or affect any dead wood habitat.

Deer and especially elk do use habitat near the proposed access routes and the development of the sites will disturb a very small area, less than a couple of acres total, of habitat for deer and elk. Given the thousands of acres of excellent early seral habitat for deer and elk on the Monument the removal or alteration of a few acres will not be substantial, and will not affect the population on the Monument. The proposed access routes are in restricted areas that currently receive little to no human use during the summer months. The amount of disturbance is insignificant at the scale of the Forest. The project is consistent with the Forest Plan, and thus continued viability of deer and elk is expected on the Gifford Pinchot National Forest.

Neotropical Migratory Birds

There would be minimal effects to birds associated with riparian hardwood shrub habitat due to minimal area of habitat affected. The proposed project would result in the removal of riparian hardwood species (willow) but in general the access routes will be located around the existing vegetation. Species associated with hardwoods, such as the *orange-crown warbler*, may lose a minimal amount of habitat to the clearing of shrubs for stream crossings. The *willow flycatcher* is another species documented to occur on the Pumice Plain that may be impacted by damage to riparian shrubs at the stream crossings. The amount of habitat that would be affected at stream crossings is a small amount of the habitat that is available; therefore effects to landbirds that are associated with early seral habitat from the project development will be minimal.

In addition, the proposed new access routes could impact ground nesting species such as the common nighthawk (observed in project area on 6/8/17).

Cumulative Effects
For deer, elk and mountain goats the effects of additional disturbance from the proposed access routes and drilling activity would accumulate to the disturbance from current recreational use on the monument which is primarily hiking as well as the effect of human presence from ongoing research. These activities may cause some habitat avoidance by deer, elk and mountain goats, primarily during the summer season. Therefore the disturbance caused by the drilling operations and development and use of the access routes would be cumulative to the disturbance effect of current human use, which in general is relatively low during most times of the year.

Future expansion of recreational opportunities at the Monument would be projects that the effects of the proposed action would accumulate to and there are a number of reasonably foreseeable future projects that are planned. These include the Coldwater Science and Learning Center camp sites, potential camping on Coldwater Lake, and the potential Kalama River camping sites. The potential development of the Crater View hiking route would be cumulative to the potential disturbance effects of the proposed Spirit Lake access route. These projects will all increase the level of recreational use of the Monument and will have the potential to incrementally increase the area of disturbance from human presence to deer, elk and mountain goats.

Alternative 1. West Access –JRO to South Shore Spirit Lake

Direct and Indirect Effects

The effects and impacts to wildlife species under Alternative 1 would be the same as the proposed action. The one exception is blasting and its effect to mountain goat. The alternative includes the potential for blasting which would likely disturb mountain goats. The geotechnical drilling also may incorporate the use of contained explosive charges that would likely disturb mountain goats as well and may cause them to avoid habitat in the vicinity of the drilling operations. In addition the development of the access route and the use of motorized vehicles would have the potential to impact mountain goats and also disturb habitat at the stream crossings. Therefore the determination for mountain goats as a result of implementing Alternative 1 is **may impact individuals or habitat but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.**

Alternative 2. – East Access from FSR 99 Along Windy Ridge to Duck Bay

Direct and Indirect Effects

This alternative would have the same determination as the other alternatives but would likely have slightly less impacts to mountain goats due to the shorter length of the route. Therefore the determination for mountain goats as a result of implementing Alternative 2 is **may impact individuals or habitat but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.**

Hydrology

Construction, maintenance, use, and periodic reconstruction of access routes across and along streams in the Pumice Plain has the potential to affect water quality and channel development processes in streams draining to Spirit Lake. Specific water quality threats include increases in sediment delivery (turbidity), water temperature, and chemical inputs. Channel development processes that may be affected include erosion of channel bed and banks, and possible capture and/or redirecting of streamflows. Ultimately these effects to channel processes could change the trajectory of channel development, and reduce nascent habitat features in affected channels that are essential to sustaining aquatic life. Effects to the aquatic environment could be short and/or long term, may be repeated over the life of the access routes, and could range from localized to affecting longer lengths of stream. Drilling could affect groundwater in the vicinity of the project, but close adherence to State drilling and drillhole abandonment guidelines should offer substantial protection of groundwater resources.

An accounting of aquatic effects of the project is challenging due to the fact that precise locations and engineering details of stream crossings, approaches to crossings, and stream-parallel segments of the proposed access routes are unknown. The number of stream crossings, particularly on the portions of proposed access route that parallel Willow Springs and Forsythe Creeks are unknown, as are the approach angles for crossings on those alignments. The channel form and condition at proposed crossings, and the proximity of stream-adjacent segments of access route on those streams is also unknown. In addition to these data gaps, the specific sites where the stream may interact with the access routes are subject to change over time due to the relatively high frequency and potentially high magnitude of channel adjustments that appear to characterize this dynamic aquatic environment.

Roads, trails or other infrastructure that cross streams, or are in the vicinity of streams tend to be some of the more challenging facilities to construct and maintain over time due to the fact that streams are the most dynamic portions of the forested landscape. On the Pumice Plain, streams are substantially more dynamic, active and subject to change than streams elsewhere on the forest. This is a result of the relative youth of this landscape, the easily erodible pumice and tephra deposits that form stream boundaries, the lack of physical channel controls including large wood and mature riparian forest vegetation along stream margins, and the proximity to an active and glaciated volcano. As a result of expected stream movement and channel changes, the location, angle of approach, and interaction of the access route with streams that are nearby is likely to change over time. Following sections of this report identify the range of effects possible, and attempt to characterize the comparative likelihood of their occurrence as best can be done with the level of information available.

Table 4. Comparison of Effects to Hydrology by Alternative.

Proposed Work Activities	**No Action**	**Proposed Action (PA)**	**Alternative 1** (JRO)	**Alternative 2** (Max Flex)
Sediment Delivery Effects				
Access Route Construction, Reconstruction, Maintenance, and	No effect	High probability of moderate amts of sediment annually for duration of access route	Effects ***lower*** than PA: Fewer points of sediment	Effects ***greater*** than PA: More points of sediment delivery

Use		existence	delivery, lower volumes of sediment delivery, and sediment delivery declines after first year	under Option 2
Drilling and Access to Sites	No effect	Minor increases at drillsites and on access routes between sites	Effects **similar** to PA	Effects **similar** to PA
Channel Processes Effects				
Access Route Construction, Reconstruction, Maintenance, and Use	No effect	Moderate probability of localized or broader effects lasting one season to multiple years. Effects are greatest where the proposed access route parallels approximately one mile of Willow Springs Creek.	Effects ***much lower*** than PA: No stream-paralleling access routes are proposed	Effects ***greater*** than PA: Under Option 1 Forsyth Creek and the unnamed stream are affected by an access route that would parallel nearly two miles of these channels. Under Option 2, Forsyth Creek, the unnamed stream, and Willow Springs Creek are all affected by an access route that parallels nearly three miles of these channels
Drilling and Access to Sites	No effect	No effect	***No effect***	***No effect***
Water Temperature Effects				
Access Route Construction, Reconstruction Maintenance, and Use (miles)	No effect	Moderate probability of very small increases in peak water temperature. This effect is localized to places on perennial streams that are crossed or paralleled by the route	Effects ***lower*** than PA: Fewer locations of temperature increase	Effects ***may be lower*** than PA ***or greater*** than PA: Under Option 1 there may be fewer locations of temperature increase due to limited summer surface flow in Forsyth Cr/unnamed stream. Under

				Option 2 there may be more locations of temperature increase due to impacts to Willow Springs, Forsyth Creek and unnamed stream
Drilling and Access to Sites	No effect	No effect	***No effect***	***No effect***
Water Chemistry Effects				
Access Route Construction, Reconstruction, Maintenance, and Use	No effect	Moderate probability of low levels of petroleum-based products reaching streams at crossings	Effects ***lower*** than PA: Fewer stream crossings and no stream-parallel access routes	Effects ***greater*** than PA: More length of stream impacted by stream-parallel access route
Drilling and Access to Sites	No effect	Low probability of delivery at drill sites and on access routes in proximity to surface water	Effects ***similar*** to PA	Effects ***similar*** to PA

No Action

Direct, Indirect and Cumulative Effects

Because there are limited—if any—similar landscapes that have been studied at this stage of development after a disturbance on the scale of Mt St Helens eruption, an estimation of future conditions under "no action" is largely conjecture since the processes and trajectory of natural recovery are still very much under study by the research community. The following effects section does not attempt to estimate the effects of natural progression except in a very coarse way. It is provided here both because it is required in the NEPA document, and to establish a general baseline from which to compare the effects of the Proposed Action and alternatives.

Under the no action alternative, drainage network development would continue at approximately the same rate and along trajectories that have been seen in the past in this environment. Episodic naturally occurring disturbances would interrupt or redirect channel processes in affected streams. As the landscape matures, disturbances related to channel avulsion, migration and mass wasting may decline in frequency and magnitude. Between major disturbances, vegetation would continue to gain additional footholds along stream margins in the planning area, incrementally increasing the structural integrity of banks. Over time, and as riparian vegetation develops, adjustments to channel location would be expected to decline, and instream habitat elements including pools, depositional areas, alcoves would likely increase. Boulders, rootmasses along the banks, and logs that have rafted into channel outlets from Spirit Lake would initiate diversity of flow hydraulics, and development of habitat complexity. Over longer periods, as trees develop and come into the channels by blowdown, erosion and undercutting,

mass wasting or fire, habitat complexity in the channels would continue to build, and the capacity to support fish and other aquatic life would be expanded.

Streams draining the area would continue to experience water temperatures in the range of what has been measured in the recent past. Over time, and as stream margins are increasingly colonized by shade-producing vegetation, the range of diel temperature swings may decrease in both summer and winter.

Sediment delivery to streams in the project area and to Spirit Lake would continue at rates and with variability similar to what has been seen in the recent past, with a slow decline as vegetation cover increases across the landscape. Sediment delivery to streams in the project area would continue to occur from the two dominant sources: upslope disturbances on Mt St Helens, and local channel processes within the planning area. Sediment delivery from surface erosion outside of the active channel areas would continue to occur at low levels.

The primary human-related influence on surface erosion in the planning area appears to be the various trails and abandoned road that crosses the Pumice Plain and that is nearly obliterated in places by gullies that have formed on the road surface. Erosion is likely to continue to occur from the road surface, and gullied portions of the road may deepen, widen and move upslope along the road. Eroded material from gullied road segments would continue to be transported downslope and some fraction of it is likely to be delivered to streams in the area. Over time and as vegetative cover in the planning area increases, surface erosion is likely to decline at some rate across the planning area.

Under no action, existing uses of the project area by hikers, researchers and others conducting work for the Mt St Helens NVM would continue. This would include foot traffic and use of a boat on Spirit Lake. Existing risk of chemical contamination in this largely pristine environment would be near zero. The existing risk of contamination would not be expected to change as a result of adopting the No Action Alternative.

In summary, the No Action alternative would have no direct or indirect effects on water temperature, sediment, or the risk of chemical contamination, nor would there be any project-related effects to channel processes or groundwater. There would also be no cumulative effects to aquatic environments associated with adoption of the No Action alternative.

Proposed Action

Direct and Indirect Effects

Table 5. Relevant Actions in the Proposed Action.

Proposed Action (PA)	Quantity and Location
Access Route Construction, Reconstruction Maintenance, and Use	• 2.75 mile route across Pumice Plain for drilling access along a pre-existing road alignment that has existed for decades • 1.0 mile new route along Willow Springs Creek alignment for long-term UTV access

Drilling Test Wells, Accessing and Preparing Drill Sites	• 25 sites

Effects to Water Temperature

No effects to water temperature would be expected from construction activities occurring away from perennially flowing streams, or from use of the access route by motorized vehicles.

At some number of the stream crossing locations and on access route alignments that follow perennially-flowing channel segments, willows and other shade-producing vegetation that grows along the stream margin would be removed to create a path for the access route. This would result in a loss of shade in a swath estimated to be 15-20' wide. These openings would offer limited increases in solar access to the stream and could result in very low levels of temperature change at specific sites, particularly if the openings occur in locations with standing or very slow moving water.

At locations where the access route crosses stream channels at near-right angles, the change in shade would be very small, and any increase in water temperature would be extremely small and difficult or impossible to detect with typical monitoring equipment. At locations where the proposed access route follows the alignment of the stream and where the access route is placed directly in the channel or in close proximity to it there is greater potential for water temperature increases because shade removal and increased solar access could occur over longer lengths of channel. It is assumed there would be limited need to cut vegetation from streambanks on much of the Willow Spring Creek alignment because there is a substantial floodplain that would allow placement of the access route well away from the stream. However, near crossings or where the access route is located south of the stream and in close proximity to it, there may be longer lengths of vegetation removal along the stream. It is estimated that less than 1% of the existing stream shade would be removed from any stream as part of the project, and as such there would be no anticipated effects to water temperature at the reach scale, and no temperature increases delivered to Spirit Lake.

Effects to Sediment Delivery

Sediment delivery to streams in the project area is expected to increase under the Proposed Action at varying levels, dependent on the specific ground disturbing activity, its intensity, duration, frequency and location on the landscape. Activities that occur away from surface channels have lower potential to increase sediment delivery to streams, but the access route itself will act as a conduit to permit delivery of sediments some distance to streams that it crosses. Those activities occurring directly in or adjacent to streams (construction, reconstruction, use and maintenance of stream crossings, crossing approaches, and stream-adjacent lengths of access route) have a higher probability of affecting sediment delivery to streams, and in most cases have the potential to deliver larger volumes of material. Drilling has the potential to deliver sediments to groundwater and to any streams or wetlands near the drilling activities, but since the actual drilling sites are not yet know with any precision, this effect is difficult to estimate. Drilling operations are specifically required to follow Washington State requirements for well drilling

and abandonment which would limit sediment delivery to groundwater from surface activities. Best Management Practices will be used throughout the project to limit sediment delivery to surface channels, and to groundwater.

Sediment delivered to streams in the project area can affect aquatic life in those streams at the site of sediment introduction and downstream, and if transported to Spirit Lake can affect aquatic life there as well. It is important to note that while this assessment indicates increased sediment delivery from project activities, streams in the project area and the biota that use them are adapted to a relatively high background level of sediment, due to the disturbance history in this area, ongoing disturbances upslope that influence the project area, and the relatively uncohesive deposits that comprise much of the pumice plain including streambanks.

The volume of sediment delivery anticipated from construction and use of the access routes represents a small fraction of the annual sediment load in these streams. However, its consistency may be finer than the background sediment contributions from natural sources, and some of the project-related sediments may occur outside the normal season of sediment delivery (i.e. project-related inputs would occur partially in the dry season).

Construction and Reconstruction of the main access route to drill sites

Disturbance and compaction of the ground surface during construction, reconstruction, maintenance and use of the access route would reduce infiltration of rainfall and snowmelt, and increase surface erosion on the access route surface. Eroded material would be routed downslope along the surface of the access route or in a drainage ditch alongside of it during periods of runoff. Because the access route has numerous stream crossings, it would likely deliver some portion of eroded sediments to streams it crosses. Waterbars are to be constructed on the access route to divert surface flows and sediments off the route before it reaches stream crossings, and although this Best Management Practice will reduce sediment routing to streams from the access route, it will not prevent it.

Constructing or reconstructing access across stream channels ranges in complexity from small streams at grade that would require little if any earthwork, to incised streams and floodplains with near vertical banks of up to 15’ in height that would require much more earthwork to construct. Sediment delivery resulting from these construction activities would be roughly commensurate with the level of construction needed at each crossing.

Steeper slopes would require substantial earthwork in proximity to the stream and/or floodplain edge to establish the necessary grade and conditions for drilling equipment and vehicle travel. Access routes at these approaches would be constructed to grades of up to 15% according to drawings prepared by the project engineer, and would exist in through-cuts up to 100’ in length where necessary to achieve specified elevation and grade. In addition to excavation for the access route surface, cutslopes on either side of the access route would be laid back to provide a stable angle of repose and to prevent the access route being buried by ravel. The resulting excavation of up to 50’ wide at the stream edge, and up to 100’ long would represent just under $1/10^{th}$ of an acre in areal cover at each location this occurs. Material from the excavation would be placed somewhere in the project area, adding to the area of newly exposed erodible surface.

The disturbed surface area at each crossing—including excavation surfaces and waste pile surfaces—would be variable in size, dependent on the depth of excavation required to get to stream level. Unless mulched, all of the newly exposed surfaces would be vulnerable to weathering and likely to experience some level of erosion from a combination of ravel, splash, sheet flow erosion, and rill or gully formation, depending on the exposed surface texture, slope and cover. As these excavations are near streams, and the ground surface likely slopes toward the stream, a portion of the eroded material is likely to end up in streams over some period of time.

Delivery of sediments would occur in pulses, with the first potential delivery occurring at the time of excavation through inadvertent, direct delivery of material into the stream. Best Management Practices employed during construction would help keep this to a low level but during construction at stream crossings there would be direct delivery of sediment to streams. Because summer months are naturally a time of relatively low turbidity in non glacially-fed streams, sediment pulses occurring at this time of year would be a notable departure from current conditions in project area streams. Peak timing of sediment delivery would occur during periods of runoff following construction/reconstruction and use of the route, and before snow accumulation begins to occur in fall or winter. This would coincide with the time that streams naturally run with higher turbidities.

Eroded material that makes its way to the stream network would increase turbidity at the point of delivery and downstream. Changes in turbidity resulting from construction activities would be greatest in the vicinity of the crossings or construction, and would attenuate downstream as a result of deposition and/or dilution from flow accumulation in the channel. Additional sediments would drop out of suspension in the low gradient stream segments approaching Spirit Lake, but finer materials would likely be delivered to the lake.

As described previously, the volume of sediment delivery anticipated from this action is small in comparison to the sediment load carried by streams in the project area during winter months, but important because it occurs partially during dry seasons, which differs from most sediment delivery that occurs from natural processes. Over longer periods, erosion of the access route surface would continue to generate sediments that would be transportable to nearby streams. Sediment delivery described here would occur for years, until the surface of the route was physically decompacted and natural drainage re-established.

Construction of the route down Willow Spring to Spirit Lake

Sediment delivery processes describe in the previous paragraphs would also occur during construction of this additional length of access route, but because this route would actually parallel, lie in close proximity, and cross Willow Springs Creek at various points, there are additional avenues of erosion and sediment delivery that make this route likely to have higher levels of sediment delivery.

Construction of an access route along the proposed alignment from Willow Spring to Spirit Lake would not be simple due to the meanders of the stream and the variability of nearby topographic features that would either lend themselves to construction of an access route, or not. The access route may at times be well away from the stream, where there is a wide, flat surface on which to construct it. At other times, the stream's meanders would put the active channel up against the

high terrace and the access route would need to either cross the channel (likely to occur at a skew to the channel), or lie directly in the channel, or be cut into the terrace slope. As the stream moves around over time, it is likely the access route would be in any combination of these locations at any given time, as dictated by stream meanders, landscape position and natural obstructions in the vicinity.

Construction and reconstruction of the route over time would require some level of heavy equipment activity along portions of the access route to move large substrates and debris, and to establish access across variable topography including approaches and ford crossings on Willow Springs Creek. Based on observed channel conditions and descriptions in the PA, the stream and floodplain along this alignment are highly dynamic. Due to potential for meandering and avulsion of the channel, any access route on the floodplain is vulnerable to erosion, loss of the running surface, or channel capture in any given year. As a result, reconstruction or maintenance of the access route is likely to be required on a relatively frequent basis, and as part of that, work may be required at multiple crossings on this length of stream. Handwork to provide access will be favored where practical, but the upper portion of the alignment in particular has larger substrates and more topographic variability that would be likely to require use of heavy equipment at some frequency to re-establish access after winter events, and possibly after periods of runoff at other times of year.

The disturbed surface area of the access route would be roughly 8' wide by a mile long or somewhere in the vicinity of one half acre in overall size. Surface runoff is likely to increase from the access route as equipment operation and vehicular traffic compacts and depresses the running surface enough to restrict infiltration and concentrate runoff. The surface would be vulnerable to weathering and likely to experience some level of erosion from a combination of splash, sheet flow, and rill or gully formation, depending on the exposed surface texture, slope and cover. Some portion of the eroded material from the access route surface is likely to end up in the adjacent stream, particularly at crossing locations.
Ground disturbance would expose earth materials during construction, during reconstruction, during maintenance, and to a lesser extent during and following use of the access route by motorized vehicles. Following initial construction of this access route, the amount of work needed to maintain or re-establish the route would be dependent on the severity of winter floods and other disturbance, and how those processes affected the channel location and form, floodplain topography and access route surface. Based on the disturbance history of this area, the likelihood of substantial changes in stream location and form from upslope channel shifts, debris flows or other processes is relatively high, suggesting that any work that is done to establish the access route in channel bottoms or floodplains would potentially need to be re-done at a relatively high frequency.

Aside from the effects related to construction and use of the access route, there may be additional inputs of sediment from channel changes or from major gully formation on the access route—not related to construction activity or vehicular use of the route. Because the access route would be a relatively smooth surface that parallels and crosses the stream, and would be compacted by heavy equipment and off road vehicles, the route would be likely to experience overland and concentrated flow of runoff. Where access route slopes increase at entry or exit points from the stream, gullies could form, and fluvial erosion could enhance those processes. Depending on the

site topography and skew of the crossings, the access route in some locations could partially capture streamflow during high flows, accelerating the gully formation process, and delivering much more substantial volumes of sediment to the stream. This introduction of material would occur during times of high flow, but once established could produce continued volumes of material over time.

Motorized use and maintenance of the access routes
Sediment delivery would be affected by continued use of the access route over time, as well as by the maintenance of the route, or by a lack of maintenance in the future, if that were to occur. Vehicular travel over the access route, and particularly the portions that cross, approach, parallel, or are located on top of streams would produce fine sediments that would end up in the streams and possibly being routed to Spirit Lake. Because use of this access route is expected to be infrequent, and primarily used by small vehicles, the amount of sediment from annual useage would be relatively small. Sediment yield from vehicle travel would be greater for travel occurring in spring months when streamflows are still high and the ground is has more moisture, and in fall when precipitation increases.

Maintenance activities including grading, re-establishing slope and drainage from the route, restoring stream crossings and doing any other repair work would typically require heavy equipment except for the most minor of activities. All maintenance that requires heavy equipment would have the potential to increase sediment delivery, but the work occurring at stream approaches and stream crossings would offer the greatest risk due to proximity and/or slope. While maintenance activities would generate sediment that is likely to be delivered as a direct result of the maintenance work, a lack of maintenance could also contribute to increased sediment delivery, by allowing drainage problems to occur and/or go unchecked. The deep gullying that has nearly obliterated sections of the existing road across the Pumice Plain is a good indication of the erosion that can occur in this landscape, on a hardened, linear surface and in the absence of maintenance.

Drilling operations
By conducting drilling in summer months when precipitation and surface erosion probabilities are low, the PA minimizes the risk of sediment introduction to groundwater from runoff occurring from the drill pad and vicinity. In addition, boreholes would be left open for a limited time to conduct tests, before being backfilled and sealed to prevent subsequent contamination. The proposed BMPs for drilling and drill pad sites are expected to be highly effective at protecting groundwater from surface sediment introduction.

Effects Related to Chemical Contamination

The most likely sources of chemical contamination to the aquatic system include leaks from equipment and vehicles working on, or transiting the access route. Contamination could occur from simple leaks, failure or damage to equipment and vehicles while onsite, and spills from trucks carrying fuel or lubricants. Best management practices including washing equipment before entering the national forest, preparation of a spill plan, and having spill response equipment onsite will reduce but not eliminate the risk of contamination.

The risk is greatest when equipment or vehicles are working/travelling in or over surface waters, or operating in close proximity to them. When further from surface waters, any leaks or spills are more likely to adsorb onto surface substrates on the ground, and/or be more containable before reaching water. On this project, equipment will be operating within active channels to establish and use stream crossings, and in all likelihood will be re-constructing and re-establishing crossings with some regularity due to the dynamic nature of the landscape and streams. Equipment and vehicles will also be travelling parallel and in some cases directly in streams where the access route alignment is unable to be located on adjacent floodplain, or where stream crossings are at such a low skew that they force travel to occur within longer segments of channel.

Because of the rough, uneven surface created by unsorted and often angular cobble and boulder materials, vehicular travel along streams will be challenging prior to creation of a smoothed travel surface. In the first passes of UTVs or heavy equipment to create and later to reconstruct these pathways, there would be increased opportunities for damage to equipment including fuel, hydraulic or lubricant systems.

Leaked or spilled materials that land in surface waters are likely to be transported downstream, and if there is surface connectivity with Spirit Lake, to reach the lake. If channels are dry during the spill/leak, then material is more likely to be adsorbed or adhere to substrates or woody material in the channel. In subsequent higher flows, some of that material may be washed downstream to lower points in the channel or possibly to Spirit Lake as well. Similarly, drips or leaks occurring in proximity to channels may end up in the stream during runoff periods when contaminated particles get entrained in the surface flow.

BMPs applied to the project are expected to reduce the potential for leaks, drips and spills, and to ensure that any leaks or spills are captured and contained as rapidly as possible. But throughout the construction, reconstruction and use of stream crossings and access routes that travel in or adjacent to streams, there will be a risk of some level of chemical contamination to the aquatic systems that are crossed or paralleled by the access route.

The probability of chemical contamination is in part a function of the frequency and duration of motorized vehicles or heavy equipment access to stream crossings and/or operating in the vicinity of streams, whether for maintenance or to access Spirit Lake. The PA suggests that the main access route would receive limited use after the drilling operation ceases, but recognizes the routes to Spirit Lake would be in use for years for maintenance and repairs needed at the tunnel inlet.

Chemical contamination at the drill sites and in any waterbodies that are encountered as equipment moves from site to site are similarly a part of this project, and BMPs are expected to reduce the risk of leaks or spills and minimize their effects on the aquatic environment. Because drilling will only occur in the first couple years after this project begins, the risk is also limited to that time period.

Effects to Channel Processes

Construction and reconstruction of the main access route to drill sites
No effects to channel processes are anticipated from construction of access routes or route segments that are built in upland locations. But as access routes approach and cross streams, there are more likely to be interactions of the access route and stream, particularly during high flows.

Because of the diversity of channel conditions in the project area, constructed stream crossings may look different at each stream crossed by the main access route. On small streams that are currently at grade with the surrounding landscape, little, or no excavation may be required to get equipment down into the channel and out the other side. On larger streams and/or more incised systems, a much larger excavation may be necessary to get equipment down to channel elevation and back up the other side.

Construction, reconstruction, maintenance and use of stream crossings on the main access route would have localized effects to streambank form and integrity by removing vegetation, physically removing and laying back streambanks, and exposing excavated bank edges to high streamflows where they are more easily eroded. Changes in bank slope and integrity can result in increased erosion on the bank, widening of the stream, and increased containment of high flows, reducing the ability of the stream to dissipate energy on floodplains. Once started, this process is self-reinforcing as increasingly higher flows are contained in the channel, and have increasing energy to further widen the channel and further enhance its capacity to contain larger flows.

Construction of crossings would include re-arrangement of stream bed materials, removing larger substrates from the access route to permit travel. The extent of this activity would vary by crossing, and over time, based on the size and position of materials left in the crossing from the previous high flow periods. There is no way to estimate the need for, or frequency of this type of work. But over time, crossings that remain in place for years would have repeated disturbance as large substrates brought into the crossing by high winter flows are moved to another location to re-establish access at the crossing. Over time, this sorting process could leave the crossings more vulnerable to erosion from loss of larger substrates, and could leave other parts of the channel to be more resistant to erosion where there is a higher concentration of large substrates. Larger substrates play an unusually important role in channel stability and creation of hydraulic and habitat diversity in these streams, because of the lack of large woody debris. Bed locations with a decreased density of large substrates would potentially lose bed stability, and would be prone to downcutting and loss of habitat features. Locations with an increased density of large substrates would potentially cause flows to spread out and increase lateral erosion on the channel banks.

Streambeds at crossings would be further altered by compaction and smoothing of the wheeltracks from the weight of equipment and vehicles on the access routes over the years of use, maintenance and reconstruction. This would result in smoothed, linear, and deepened features at each crossing. When crossings occur at a skew to the channel, the wheeltracks are likely to accelerate flow velocities, and would tend to redirect flowpaths toward the streambank at the downstream end of the skewed crossing, increasing fluvial erosion on those banks. Some of the wheeltracks at stream crossings would be scoured and removed from the channel bed

during annual high flows, but it is likely that some crossings would retain the compacted and deepened features over the years of use. The longer these features remain in place without being removed by streambed mobilization, the more established and entrenched they would become, and the more effective they would be at redirecting flowpaths within the stream.

Since crossing locations are liable to change over time due to changes in stream position on the landscape or changes in accessibility to the stream, the effects described above may occur in multiple locations over the course of years for any particular crossing.

Because annual high flows are a certainty, and other disturbance processes are likely or probable in this landscape, there is near certainty that crossings and access routes that parallel or overlie streams will need relatively frequent repair and/or reconstruction. Consequently, the effects to channel processes would be repeated annually or at some frequency, possibly more than once per year for maintenance and repair, and potentially at multiple locations along each stream. These effects may contribute to a change in the trajectory of channel recovery, long term changes in channel form, and changes to habitat for fish and other aquatic organisms.

The effects of stream crossing and access route construction as described in the previous paragraphs may persist over time, but could also be washed out or obscured at some frequency by larger natural disturbance processes that cause channels to avulse, rapidly meander, scour, or become buried by deposits from upstream mass wasting. While it is not possible to predict the scope and scale of future natural disturbance processes, or their impact on these channels, it is likely that effects of this proposed action would have some effects on channel processes, and that the streams would also experience natural disturbances as well. Some of the natural disturbances would in effect reset the stream conditions, wiping out any anthropogenic disturbances, and some may actually enhance or exacerbate effects of the proposed action on channel processes.

Construction of the access route to Willow Springs

The effects of constructing this segment of access route are similar to those described above, but because the entire segment would lie parallel to the stream channel, there are additional pathways for affecting channel processes.

The proposed action identifies an alignment that roughly parallels, and is at times within the channel migration zone of Willow Springs Creek. The creek follows a sinuous course, ranging across a variable swath of up to hundreds of feet in width. Multiple channel scars across the floodprone area provide evidence of current and past channel movement and high flow activity. At any given time and location on the proposed access route alignment, the active channel may be alternately located along the left or right floodplain edge, suggesting a challenge to locating and constructing a continuous access route that doesn't cross back and forth across the channel. For that reason, it is assumed the proposed access route would end up in different positions relative to the active channel over time, crossing when needed to access a relatively flatter portion of the floodplain, or when the floodplain is lost on one side due to channel meander or avulsion. In addition to having multiple stream crossings, this route would lie in various positions relative to the stream—some segments would be far from the stream on the broad floodprone area, and others would lie in close proximity to the active channel when that is the only available option on the stream corridor.

Construction, reconstruction and maintenance required for the access route includes activities that range from moving cobble and rubble by hand, to using heavy equipment to create access to crossings, or to lower the grade of streambanks, move larger rocks, establish ford crossings, create safe cross slopes, and /or to establish transitions from surfaces that differ in elevation including entering the incised floodplain and accessing stream ford sites.

During construction of the access route, the selected alignment would be cleared of large obstructions, compacted by heavy equipment, and smoothed over time by multiple passes of equipment and vehicles. Once the route is constructed, it represents a straighter and smoother route for surface water drainage than the natural channel, because the access route would not likely be constructed with the sinuosity of a stream. Because it discourages infiltration, the compacted surface of the access route would intercept precipitation and snowmelt and route it downslope along the wheeltracks of the access route. Where it is in proximity to the stream, the access route may also receive surface flow from the stream when the flow is high, and exceeds the streambanks.

As water is contained and concentrated in wheeltracks on the access route—from any combination of precipitation, snowmelt, and/or high flows from the stream, it may deepen the wheeltracks by erosion. As wheeltracks that are roughly parallel and in proximity to Willow Springs Creek deepen over the years of use, there would be an increasing risk of streamflows from the adjacent stream accessing and flowing down the wheeltracks. Because the wheeltracks would be smoother, straighter and steeper than the natural channel, surface water would preferentially follow that route if given access. Capture of any portion of the streamflow would substantially increase erosive forces on the wheeltracks, and could lead to incision, widening, and potentially capture of an increasing share of flow from the channel. Over the course of the many years that this project is intended to serve, it is likely this process will occur at some level, and on some portions of the access route. It is not a certainty, and would likely not occur on all segments of the route, but where it does occur, it has the potential to affect longer lengths of stream.

The likelihood of this process happening at some scale is relatively high under the proposed action, but the extent and importance of the changes would be affected by a range of factors including the elevation difference between stream and floodplain where the access route is located and at approaches to stream crossings, the skew of proposed crossings, and site details. Effects could be as minor as localized gullying of the access route at stream approaches, to an artificially created side channel or avulsion along the access route alignment if some or all of the streamflow is captured on the access route.

Any effect on channel processes that occurs as a result of this proposed action would be limited to this drainage, and would not extend outside of Willow Springs system. It is possible that effects described here would not be persistent over long time periods, as the stream and floodplain are highly dynamic and in a landscape position that is subject to significant disturbances from higher on Mt St Helens. But it is also possible that natural disturbances would enhance the described effects of the access route on streams.

Motorized use of the access routes

Use of stream crossings by ATVs and UTVs would enhance compaction of access routes at crossings, and directly disturb and compact streambanks and channel substrates at crossing sites. On those sections of access route that parallel streams or are actually within the active channel, continued use of the access route by vehicles would tend to enhance the concentration of flows along wheeltracks, and accelerate flow velocities as described previously in this section, contributing to erosion along the access route, potentially splitting flow off the main channel or capturing the entire flow of the channel as incision develops in wheeltracks.

Drilling Operations
Drilling activities would have no effect on channel processes

Cumulative Effects
In addition to the direct and indirect effects described above, implementation of the Proposed Action has the potential to result in cumulative effects to the aquatic environment when considered in context with other activities that have previously occurred in the planning area, that are ongoing in that area, or that are anticipated. Table 2 identifies a list of other activities in this planning area that were considered for potential cumulative effects. The past actions to construct and/or maintain a road across the Pumice Plain, and the efforts to drill in the project area would have potential cumulative effects to water quality, but because these activities occurred some 30 years ago, there are no expected cumulative effects with the current proposal. The ongoing and potential future activities that involve researchers or public accessing the project area are not likely to have cumulative effects to the aquatic environment because those activities are so minor in areal extent, and in magnitude of impact compared to the proposed action and the natural disturbance regime.

Alternative 1. West Access –JRO to South Shore Spirit Lake

Direct and Indirect Effects

Table 6. Relevant Actions in Alternative 1.

Alternative 1 Actions	Quantity and Location
Access Route Construction, Reconstruction Maintenance, and Use	• 3.0 mile of new and existing route from JRO to the Pumice Plain for drilling access
Drilling Test Wells, Accessing and Preparing Drill Sites	• 25 sites

Aquatic Effects of Alternative 1
Under this alternative, access to drill sites and Spirit Lake would be from the north, with a three mile route leaving Johnston Ridge Observatory and following the alignment of existing trails down to the Hummocks on the north end of the Pumice Plain. The landscape traversed by the route from JRO follows ridgelines at gentle grades for about half its length before dropping down the south slope of Johnston Ridge to the Hummocks. No stream crossings exist on the first

half of the route, and those that exist on the slopes of Johnston Ridge are more stable in their alignment than the less steep channels crossing the Pumice Plain. Additional stream crossings would occur in the Hummocks area, but these streams appear to be less well-connnected to upper slopes of the mountain, so probably receive less disturbance in the way of debris flows and other events sourced higher on the mountain.

Effects of this alternative are similar in nature to those described for the PA but substantially lower in magnitude and distribution. Under this alternative, the single access route would have less interaction with streams—fewer crossings, shorter crossings, crossing sites that are less likely to change from year-to-year, and less of the proposed access route lying parallel to, or within streams. Although construction of this access route may require more physical ground disturbance at specific locations in construction, the route is more likely to remain in place over time and require less maintenance and reconstruction, due to the more stable landscape position and construction techniques available.

Combined, these differences would result in lower potential shade removal on perennial streams, and lower risk of heating. With fewer crossings, less length of access route lying parallel and in proximity to channels, and less maintenance and reconstruction of the route over time, there would be substantially less sediment delivery and lower risk of chemical contamination in comparison with the Proposed Action. Channel processes would be affected in a more limited way because of the reduced number of crossings and stream-parallel reaches of access route, and also because the streams in this part of the planning appear to be more stable—channels draining Johnston Ridge are steeper and less likely to move laterally, and streams in the Hummocks have more landform control than streams draining from the mountain across the relatively gentle slopes of the Pumice Plain.

Cumulative Effects

In addition to the direct and indirect effects described above, implementation of this Alternative has the potential to result in cumulative effects to the aquatic environment when considered in context with other activities that have previously occurred in the planning area, that are ongoing in that area, or that are anticipated. Table 2 identifies a list of other activities in this planning area that were considered for potential cumulative effects. The past actions to construct and/or maintain a road across the Pumice Plain, and the efforts to drill in the project area would have potential cumulative effects to water quality, but because these activities occurred some 30 years ago, there are no expected cumulative effects with the current proposal. The ongoing and potential future activities that involve researchers or public accessing the project area are not likely to have cumulative effects to the aquatic environment because those activities are so minor in areal extent, and in magnitude of impact compared to the proposed action and the natural disturbance regime.

Alternative 2. – East Access from FSR 99 Along Windy Ridge to Duck Bay

Direct and Indirect Effects

Table 7. Relevant Actions in Alternative 2.

Alternative 2 Actions	Quantity and Location
Access Route Construction, Reconstruction Maintenance, and Use	*Option 1* • Use a helicopter to fly-in drill equipment to project area, negating the need for a motorized route *Option 2* • If drilling equipment cannot be flown in via helicopter, construction, reconstruction and use of route across the Pumice Plain from FSR 99 Extension to access drill site, along a pre-existing road alignment that has existed for decades (2.75 miles). Route would be in place for 1-2 seasons.
Construction and Use of UTV Access Route for Long-Term Maintenance	*Option 1* • New route along Forsyth Creek to Spirit Lake (1.9 mile) *Option 2* • New route along Forsyth Creek to Spirit Lake (1.9 mile), and if this route cannot be sustained, new route along Willow Springs Creek (1.0 mile)
Drilling Test Wells, Accessing and Preparing Drill Sites	• 25 sites (this occurs under all options shown above)

Aquatic Effects of Alternative 2

Alternative 2 includes two scenarios for providing access for drill rigs and equipment, and two scenarios for providing access to Spirit Lake under this alternative. If the access route for drilling or the UTV route down Willow Springs is not needed, effects to aquatic resources would be reduced.

When all things are considered, this alternative is expected to have similar but greater effects to the aquatic environment than were described for the Proposed Action, regardless of the options selected. This alternative would also be more impactful than either No Action, or Alternative 1. This option would have the greatest aquatic effect because it impacts—at a minimum—segments of Forsyth Creek and an unnamed stream that is greater than the length of Willow Springs Creek. It proposes stream-paralleling access routes that would necessarily be in close proximity to those streams, and at some locations would be directly in those channels, or on steep sideslopes above them. The access routes along these channels are likely to include an unknown number of stream crossings. This alternative may also affect Willow Springs Creek with a stream-paralleling access route and some number of stream crossings on that stream.

Effects to Water Temperature

Effects on water temperature are similar to those described previously in this report for the Proposed Action. Differences under this alternative include: there is uncertainty as to how much of Forsyth Creek and the unnamed stream have perennial surface flow that would be subject to heating; there is uncertainty about where the access route would be located with respect to those perennial reaches of Forsyth Creek; and it is likely the access route along Forsyth Creek would be closer to the stream (and thus may require removal of vegetation that is currently providing shade to the stream). The photos below provide an example of the challenges with estimating shade loss. Figure 31 shows a stream reach with no surface flow, and no existing shade. The project would not be expected to have any effects on water temperature in this particular reach.

Figure 31. Stream section showing no surface flow or shade.

Figure 32 shows a stream reach that appears to be narrow, confined by steep sideslopes, and well vegetated. It is unknown whether there is perennial flow in this reach or not. Access route placement in this reach would either require placing the route in the stream bottom and driving over the riparian vegetation that currently provides shade to the channel, or placing the access route in an upslope position, where there would need to be earthwork and stabilization to allow construction. If this reach has perennial flow, or begins to flow perennially over time, and if the channel is placed at the bottom of these sideslopes, the stream would be more exposed to solar radiation and water temperature may be elevated.

Figure 32. Narrower, confined stream section that's well vegetated.

Effects to Sediment Delivery

Effects of this alternative would be similar to those described for the Proposed Action, with some exceptions due to the length of access route to be constructed, differences in the natural landforms and hydrology of Forsyth Creek and the unnamed stream, and to project designs. As noted previously, the Forsyth Creek alignment became an option late in the planning process, so has had limited, if any engineering review. This leaves questions as to how the route would be placed with respect to the stream and the steep sideslopes that exist along portions of it. The narrower channel and in some cases lack of floodplain leave less flat ground near the active channel to support the access route, and in some cases would require the access route to be located immediately adjacent to the active channel, in the channel, or on steep sideslopes above the channel. Under this alternative, there would be greater length of access route paralleling or in close proximity to streams than under any other alternative, increasing the likelihood and volume of sediment delivery expected to occur.

Effects related to Chemical Contamination

The risk of chemical contamination under this alternative is similar to what was described for the Proposed Action, but greater due to the increased length of channel-adjacent access route, closer proximity of the access route to the channel, and potential for some segments of route to be placed directly in the active channel.

Effects to Channel Processes

Effects of the construction, maintenance, periodic reconstruction and use of this route are similar to those described for the Proposed Action, but greater. They are greater under this alternative because three streams are potentially impacted by stream-parallel segments of access route under this alternative: Willow Springs, Forsyth Creek and the unnamed stream. In addition, because Forsyth Creek and the unnamed stream are more confined in places, the access route along those streams is likely to be in closer proximity to the streams than the route on Willow Springs Creek that is in the Proposed Action.

Cumulative Effects

In addition to the direct and indirect effects described above, implementation of Alternative 2 has the potential to result in cumulative effects to the aquatic environment when considered in context with other activities that have previously occurred in the planning area, that are ongoing in that area, or that are anticipated. Table 2 identifies a list of other activities in this planning area that were considered for potential cumulative effects. The past actions to construct and/or maintain a road across the pumice plain, and the efforts to drill in the project area would have potential cumulative effects to water quality, but because these activities occurred some 30 years ago, there are no expected cumulative effects with the current proposal. The ongoing and potential future activities that involve researchers or public accessing the project area by foot are not likely to have cumulative effects to the aquatic environment because those activities are so minor in areal extent, and in magnitude of impact compared to the proposed action and the natural disturbance regime.

Aquatic Conservation Strategy

The project is located on the north flanks of Mt St Helens between the crater and Spirit Lake. The project area represents a landscape that was re-created less than 40 years ago when the north side of the mountain failed, and the resulting debris avalanche and pyroclastic flows buried everything that remained on the north side of the mountain. All forms of life were assumed to have been incinerated during the blast, and much of the pre-existing landscape was physically moved downslope in a massive debris avalanche that went down the Toutle River. No trees remained, no stream channels remained, and no life remained in streams draining the north side of the mountain or in Spirit Lake.

Since the 1980 eruption, the project area has been going through an evolution that involves establishment of new drainage networks, development of vegetative cover and the return of biological life of all forms. This process has been the focus of much research and has provided an unparalleled opportunity to observe and quantify successional processes in a landscape that was essentially reset to zero.

Re-establishment of a drainage network began immediately after the eruption as rills and gullies forming on the unchanneled deposits of tephra and pumice coalesced into larger channels that then deepened, widened, changed course, and in some cases captured flow from adjacent streams. In comments to the original Spirit Lake Access Route EA, Jon Major describes a series of channel avulsions that provides an excellent description of how active and changeable streams can be at this stage of development and on a landscape with little physical control. As Major describes it:

> "I offer the following observations with regard to Loowit Creek which drains the crater and now flows into North Fork Toutle River. In the mid-1990s, this creek flowed into North Fork Toutle. Sometime between 1996 and 2003 it avulsed its position and began flowing directly into Spirit Lake. That positional avulsion was likely triggered by occurrence of debris flows from the crater. During a large storm in 1994, that channel avulsed again and the creek began flowing back into North Fork Toutle River via that channel it occupied in the mid-1990s. During a large storm in 2006, Loowit Creek avulsed to a new channel east of the channel it had been flowing in, but remained draining into North Fork Toutle—it did not switch to flowing into Spirit Lake."

When Loowit Creek avulsed to the east and began flowing to Spirit Lake, this would have represented a substantial additional volume of both sediment and water to streams on that side that were already flowing to Spirit Lake at much lower volume. Depending on how the event played out, this process could have either set back, or accelerated the process of channel development in the receiving channel(s) that flowed to Spirit Lake. Because this process along with other disturbances have happened any number of times and on any number of stream combinations in the past 38 years, and has not affected all streams uniformly, channels draining the project area exhibit a wide range of developmental progress in terms of recovering from the effects of eruption and post-eruption disturbance.

In a general sense, recovery in this landscape implies some sense of dynamic stability so that habitat elements can develop to support life in and around the channel. In forested environments, riparian vegetation with rootmasses along the stream margin, and large trees standing and horizontal along the channel provide an essential structural presence that helps provide stability to streams, as well as hydraulic diversity. In a landscape with highly erodible deposits such as the Pumice Plain, before vegetation gets established on the stream margins, the only real resistance to flow comes from larger substrates—boulders and large rock fragments that provide obstruction to flow, or large masses of debris from mass wasting events that set up in or adjacent to the channel.

As the drainage network has developed, the extent of perennial surface flow in channels has increased (personal communication with Charlie Crissafulli 2017), extending and increasing the available habitat for aquatic life. Vegetation along streams and riparian areas has increased dramatically since the early years following eruption and in response to the availability of water and the reduced magnitude and frequency of disturbance. As vegetation returns, root development on channel margins provides increased bank integrity, reducing lateral erosion and allowing for development of increased hydraulic diversity in channels that have for years been dominated by riffle habitats. As riparian canopies develop and coalesce, increasing shade reduces water temperature fluctuations and provides organic litter to streams, a critical component to aquatic life.

With these physical changes in channels and riparian areas, biological life in the channels has followed. Invertebrates, amphibians, and ultimately fish have moved back into many of these once barren streams. Tara Blackman conducted research on streams north of the mountain in

2012-2013, and her thesis describes the return of fish to streams in the project area (streams in the project area are referred to as "PF streams" in her paper):

> "Gillnetting in Spirit Lake in the years immediately following the eruption yielded no fish (Crawford 1996, Lucas and Weinheimer 2003). However, Rainbow Trout (O. mykiss) were observed in Spirit Lake in 1993, likely the result of clandestine stocking, and have since maintained a self-sustaining population (Bisson et al. 2005, Crisafulli unpublished). Several of the lake's tributaries were visually surveyed and electroshocked between 1983 and 2005; fish were not observed in any stream draining into Spirit Lake (Lucas and Weinheimer 2003, Crisafulli unpublished). In the summer of 2011, fry were visually observed in two PF streams. In 2012 four streams on the PF zone and one stream in the BD zone were electrofished…" (page 14) and later she states "Fish were observed in all streams with the exception of Willow Springs." (page 18). [Note that she surveyed Willow Springs Creek and 3 other streams on the Pumice Plain, but did not survey Forsythe Creek which lies south of Willow Springs Creek.]

Aquatic Conservation Strategy Objectives

Objective 1: *Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.* Watershed or landscape-scale features include the Pumice Plains, the drainage networks, the patches and linear expanses of shrub and hardwood vegetative cover, and Spirit Lake itself.

Objective 2: *Maintain and restore spatial and temporal connectivity within and between watersheds.* Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species. Connectivity is provided by contiguous vegetative cover, unobstructed water movement through surface and subsurface pathways, delivery and movement of substrates and wood, passage for aquatic and riparian species.

Objective 3: *Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.* Integrity of the aquatic system in this environment is reliant on vegetation, roots, large substrates, and existing banks that have developed a stable form.

Objective 4: *Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems.* Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities. Water quality parameters of greatest concern include water temperature (oxygen), turbidity or sediment delivery to streams, and chemical inputs. Water quality in this landscape is unaffected by development or land uses upslope, but may reflect the volcanic origin of substrates and the volcano's influence on groundwater in the area. Rainbow trout and a host of amphibians, reptiles, invertebrates are or are likely to be occupying habitats in the project area.

Objective 5: *Maintain and restore the sediment regime under which aquatic ecosystems evolved.* Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport. The sediment regime in the planning area is dominated by erosion and transport of pyroclastic materials that are stripped from streambanks, streambeds, and erosional surfaces on the Pumice Plain, and from episodic delivery of mixed substrates that occurs by debris flows or other mass wasting from upslope areas. Sediment delivery is presumed to be relatively high in the planning area. Delivery and transport occurs largely in the wet season, and storage of materials occurs in channels and on fans near channel outlets on Spirit Lake.

Objective 6: *Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.* Instream flows are affected by drainage area, the porosity and water holding/transmission characteristics of the pyroclastic flow deposits that dominate the landscape, and by the state of the developing drainage network. Peak and high flows occur in fall through winter in response to heavy rain, rain-on-snow, and warm weather snowmelt, and low flows occur in late summer.

Objective 7: *Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.* The timing, variability and duration of floodplain inundation, and the water table elevation in meadows and wetlands is a function of precipitation, snowmelt, channel condition, and the porosity and water holding/transmission characteristics of the pyroclastic flow deposits that dominate the landscape.

Objective 8: *Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.* Species composition and diversity of plant communities in riparian areas is a function of the species that have colonized the Pumice Plain and stream margins. With exception of human uses on the existing trail(s) on the Pumice Plain, and seed that was transported in by wind or during the original drilling operations for the Spirit Lake tunnel, the species mixes onsite are likely to reflect native plant origins.

Objective 9: *Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.* Native plant, invertebrate and vertebrate riparian-dependent species in the planning area are assumed to be similar to those found elsewhere in this elevation range in other west side locations on the forest.

Soil Resources

No Action

Direct and Indirect Effects

Soil Formation

There would be no changes to ongoing soil formation or losses in soil quality expected in this alternative. No increases in the extent or severity of soils compaction would be caused due to no action by management.

Erosion

Erosion rates would not increase due to no action by management and would continue at current rates where undisturbed. Soils with high potential for erosion would not be utilized for vehicular traffic.

Pyroclastic Flow Features

No changes to unique or fragile features of the pyroclastic flow would occur due to no action by management.

Cumulative Effects

There would be no cumulative effects caused by the no action alternative because it would not change soil conditions in the area.

Proposed Action

Direct and Indirect Effects

Important areas with a high Biophysical Sensitivity Rating would be protected with proper project design features. Losses in soil formation would occur due to minor amounts additional compaction and displacement caused by the proposed activities. The extent of soil disturbance to areas previously undisturbed is expected to be relatively minor.

There would be no transport of rock, soil, and plant material from off-site. Although this limits traditional erosion control measures, imported materials would bring significant ecological risks associated with invasive species.

The Proposed Action would potentially decrease soil quality in areas with high to very high "Biophysical Sensitivity Rating" on the Debris Avalanche, various Uplands, Spirit Lake Basin, and Pyroclastic flow deposits (CMP Appendix B, Table 3). Of concern are the processes of Soil Formation, Erosion, and the Physical features in the Pyroclastic flow, surface texture, succession processes on Spirit Lake shoreline, and Fluvial features (channels).

Locations of decreased soil quality would likely be limited to sites that receive vehicle traffic and earth-moving activity. Further soil losses could occur due to erosion triggered by earthwork, soil disturbance by vehicles and equipment.

Soil conditions on some areas are sensitive to disturbance and may lead to off-site effects, including increased erosion rates and diverted or intercepted water due to soil disturbance.

Long-term UTV Access
At the scale of the analysis area, effects to soils due to long-term UTV access down Willow Springs would not prevent or degrade "natural geologic and ecologic processes and integrity of the resources" over deposits and Biophysical Areas that are documented as "needing care during development and use to remain within the intent of the Act." Nature and distribution of the highest magnitude negative soil impacts due to compaction, displacement, and erosion are dispersed across the stream crossings on the Truman Trail access.

Exploratory Drilling
The highest concentration of soil disturbance and potential negative soil impacts would occur at the drilling pads and routes used to access them. Drilling operations would displace and compact soils in areas developed for the drill platform or pad. This disturbance would cause long-term setbacks in soil formation and would potentially cause erosion. Some leakage of drill water and petroleum products could contaminate the soil, but would be minimal with careful drilling practices. Potential issues could arise from traveling to sites where steep pitches would be crossed and where soils are more prone to erosion when moved. If heavy equipment such as drill rigs were to travel on areas steeper than 15 or 20 percent slope, direct soil impacts and erosion could degrade "natural geologic and ecologic processes and integrity of the resources" over deposits and Biophysical Areas that are documented as "needing care during development and use to remain within the intent of the Act."

Soil Formation

Soil Formation would be impacted by increases in the extent and severity of soil compaction due to proposed action by management. Areas where earthwork would cut through pyroclastic deposits would likely experience erosion. Areas could stabilize with plants that naturally colonize the bare soils, but will probably not stabilize where excavation is required to maintain a drivable path. Compaction and displacement from the existing road bed and connecting trails would increase the existing footprint of some trails.

Reentry into the area with vehicles would cause minimal increases in soil compaction, inhibiting soil formation on the travelling paths and potentially reducing it alongside the access route. Soil displacement instantly removes soil and along with it, developed soil properties and benefits.

Away from the access route and temporary drilling paths, soil formation would continue unimpeded.

Erosion

Soil loss by erosion as an indirect effect of soil disturbance would occur. Sites most affected would be sensitive soils on the Pumice Plain. Some losses would be mitigated with design features. Potential for increased erosion would be relatively more risky with Alternative 1 access from Johnston Ridge due to steep slopes and the amount of trail widening involved. Both routes appear feasible with enough engineering design and erosion control.

Pyroclastic Flow Features

Access via Windy Ridge would have relatively less risk for damage to biophysically sensitive pyroclastic flow soils because of the shorter amount of route construction over that soil type. Although more disturbance activities at stream crossings are required, stream crossings from the Proposed Action would disturb more resilient soil types than Alternative 1.

Spirit Lake Shoreline

Prohibitions on dispersed recreation and development would preserve unique features and erosional processes. Minimal use and occasional traffic by maintenance workers would cause temporary disturbance to designated trails and work areas.

Use of Willow Springs Channel adjacent to and not in the active channel would minimize disturbance to soils and bank slopes outside the channel.

Cumulative Effects

Past effects to soil resources is included in the existing condition. An increase in vehicular traffic due to new or easier access to undeveloped, sensitive areas has a potential to damage soil quality on sensitive areas, and the extent would increase over time.

Alternative 1. West Access –JRO to South Shore Spirit Lake

Soil Formation

Soil Formation would be impacted by increases in the extent and severity of soil compaction and displacement on the west route. Compaction and displacement from the existing road bed and connecting trails would increase the existing footprint of some trails. Compared to the Proposed Action, a greater extent of soil along trails would be displaced due to trail widening required in steep topography. Changes to soil processes would be greater than the Proposed Action and long term. Away from the path, soil formation would continue unimpeded.

Erosion

Loss of soil by erosion as an indirect effect of soil disturbance would be mitigated with erosion control measures. Potential for increased erosion would be higher on the west access from Johnston Ridge due to steep slopes and earthwork involved with trail widening.

Pyroclastic Flow Features

East access via Windy Ridge would have relatively less risk for damage to biophysically sensitive pyroclastic flow soils because of the shorter amount of route construction over that soil type. Although more disturbance activities at stream crossings are required, stream crossings from the east route would disturb more resilient soil types than the west access route.

Spirit Lake Shoreline

Prohibitions on dispersed recreation and development would preserve unique features and erosional processes. Minimal use and occasional traffic by maintenance workers would cause temporary disturbance to designated trails and work areas.

Use of Willow Springs Channel adjacent to and not in the active channel would minimize disturbance to soils and bank slopes outside the channel.

Cumulative Effects

Past effects to soil resources is included in the existing condition. An increase in vehicular traffic due to new or easier access to undeveloped, sensitive areas has a potential to damage soil quality on sensitive areas, and the extent would increase over time.

Alternative 2. – East Access from FSR 99 Along Windy Ridge to Duck Bay

Direct and Indirect Effects

The activities that are the same as the proposed action are described in that section. Only actions unique to Alternative 2 are described here.

Long-term UTV Access

Undisturbed soils would receive a moderate level of damage to soil formation on a small area in the long term. Long-term damage beginning at upper stream banks into next streams would also result where the UTV will leave the Forsyth Creek channel to cross east toward Duck Bay.

Option 2 uses the same route with related specifications as the Proposed Action Alternative, with a greater emphasis on helicopter use. Ironically, this Alternative would potentially result in greater amounts of soil damage because of the risk involved with Option 1. Choosing Option 1`is not certain to succeed in the long term for logistical and water resource reasons, as preferable as it might be for soil protection. Failure of Option 1 to succeed would mean a change of operations to Option 2, which leaves soil damage on both routes.

Cumulative Effects

Past effects to soil resources is included in the existing condition. An increase in vehicular traffic due to new or easier access to undeveloped, sensitive areas has a potential to damage soil quality on sensitive areas, and the extent would increase over time. As discussed above, failure of Option 1 to succeed would mean a change of operations to Option 2, leaving soil damage on both routes. The extent of long-term damage expected from of Option 1 is relatively small, limited to an estimated 50-100 meters of trail length outside of stream channels.

Fisheries

No Action

Direct, Indirect and Cumulative Effects

There are no effects to fish or fish habitat from the no action alternative because no streams or fish species would be impacted by any management action. There would be no direct, indirect, or cumulative effects to rainbow trout, the only fish species present in the project area, because there would not be any foot or vehicular traffic, heavy equipment travel, or ground-disturbing activities instream or on streambanks, nor would there be any drilling for core samples and associated water withdrawal.

Proposed Action

Direct and Indirect Effects

Federally Listed Fish Species

There are no fish species proposed or designated as Sensitive by the Forest Service in or downstream of the project area. This includes: inland redband trout, pygmy whitefish, Puget Sound coastal cutthroat trout, and Puget Sound/Strait of Georgia Coho Salmon. Therefore, the existing population and habitat conditions would remain the same and there would be **no effect** to Sensitive fish species.

Sensitive Fish Species

There are no fish species designated as sensitive by the Forest Service in or downstream of the project area. This includes: inland redband trout, pygmy whitefish, Puget Sound coastal cutthroat trout, and Puget Sound/Strait of Georgia Coho Salmon. Therefore, the existing population and habitat conditions would remain the same and there would be **no effect** to Sensitive fish species.

Management Indicator Species

The Gifford Pinchot National Forest Land and Resource Management Plan (USDA 1990) identifies Management Indicator Species (MIS). These species may use habitat that is limited in availability, or could be reduced in availability, due to management activities. Because National Forests manage habitat rather than populations, the Forest Plan indicators are expressed in terms of habitat capability. One or two management indicator species (MIS) were identified for each group of species with similar habitat requirements. The Forest Plan designated cutthroat trout/steelhead trout and bull trout as MIS indicators to represent various aquatic habitats on the Gifford Pinchot National Forest. However, none of these fish species are present in or downstream of the project area. Therefore, the existing population and habitat conditions would remain the same and there would be **no effect** to Management Indicator Species.

Critical Habitat

There are no proposed or designated Critical Habitat for Federally-listed fish species in or downstream of the project area. Therefore, the existing conditions would remain the same and there would be **no effect** to Critical Habitat.

Essential Fish Habitat

Essential Fish Habitat (EFH) has been designated under the Magnuson-Stevens Act to protect waters and substrates necessary for Chinook, coho, and pink salmon spawning, breeding, feeding, and growth to maturity (USDC 1997). There are no pink salmon or designated EFH for pink salmon on the Gifford Pinchot National Forest, and there is no EFH for coho or Chinook in or downstream of the project area. Therefore, there would be **no effect** to EFH from the project.

Non-Listed Resident Fish Species

There are some activities proposed on, or near, streams feeding into Spirit Lake that contain rainbow trout. These are resident (i.e. non-anadromous) fish that are not Federally-listed under the Endangered Species Act, not listed as Forest Service Sensitive, and not designated as Management Indicator Species. These rainbow trout are believed to have been illegally stocked in Spirit Lake following the eruption of Mount St. Helens and are also believed to be present and spawning in several of the streams that drain into Spirit Lake. In a recent study of rainbow trout in the project area, researchers found that at least four streams that would be crossed or are near the proposed access route had perennial flow and most contained fish. The Master's thesis that resulted from this study (Blackman 2014) is available in the Project Record.

The proposed action includes: (1) drilling of 25 bore holes for core sampling of debris avalanche, (2) water withdrawal for drilling for 1-2 years from Spirit Lake and potentially some streams, (3) the construction and UTV usage of a motorized route extending from the current terminus of FSR 99 to the drilling locations for 1-2 years, and (4) the construction and long-term UTV usage of a motorized route from Willow Springs to Spirit Lake. These motorized routes include the construction and usage of 10-20 stream crossings. Further details can be found in the *Proposed Action and Alternatives* section of this EA. Direct, negative effects to rainbow trout from this proposed action, including both access route options, could occur in certain stream reaches due to direct contact with people, vehicles, and equipment during the construction, maintenance, and ongoing usage phases of this project, as well as by direct contact with rock added during construction and maintenance activities. Direct, negative effects to rainbow trout in certain stream reaches could also result from water quality degradation, including potential increases in water temperature, turbidity, and chemical inputs during the construction, maintenance, and ongoing usage/travel phases. Design features that are expected to protect fish and fish habitat from direct negative effects due to water drafting, petroleum/chemical spills, and transport of aquatic invasive species would be in place during the construction, maintenance, and ongoing usage phases of this project. In addition to injury and mortality, these potential impacts to water quality could result in: changes in metabolic function and feeding rates, reduced predator avoidance capabilities, increased susceptibility to disease and parasites, displacement from optimal feeding habitat for juveniles and adults, and displacement from optimal spawning habitat and reduced spawning success for adults. Therefore, these potential direct effects could impact all life-stages of rainbow trout present in the project area (i.e. eggs, alevin, parr, adults, spawners) and would be expected to be long-term, intermittent, and localized.

Indirect effects could also potentially negatively impact all life-stages of rainbow trout present in Spirit Lake, as well as in certain streams draining into Spirit Lake. These indirect effects would have the same causal mechanisms as the direct effects, with the exception of injury and mortality due to direct contact with people, vehicles, and equipment. These indirect effects are also expected to be long-term, intermittent, and localized. While the highly-erodible characteristics of the streambanks, streambeds, lakeshore, and upland areas are expected to increase the negative effects of vehicular travel and ground-disturbing activities on rainbow trout, these fish are currently spawning in streams and living in a lake that have naturally high background turbidity levels and project design criteria would be implemented to reduce erosion levels.

Additionally, the small magnitude and highly localized nature of potential water temperature increases from streambank vegetation removal and drilling operations would not be expected to impact fish beyond possible slight changes in metabolic and feeding rates, and the water withdrawal associated with drilling activities is not expected to result in elevated stream temperatures, although there may be some slight intermittent and localized increases in turbidity. Other potential impacts to water quality from drilling operations would be minimized or eliminated through the implementation of Best Management Practices and design features. There is some risk of chemical contamination of aquatic systems due to heavy equipment and vehicular spills and leaks but, because of the Best Management Practices that will be implemented, the risk to fish would be minimized.

Finally, the risk to fish and fish habitat from the transport of aquatic invasive species will be minimized with the strict implementation of design features during all phases of this project. Greater detail regarding the proposed action can be found in the *Proposed Action and Alternatives* section of this EA and a full discussion regarding potential impacts to fish habitat, as well as Best Management Practices and design features, can be found in the project Hydrology Report (see Project Record).

New Zealand Mud Snail

In early 2018, the Monument Manager was made aware of the detection of the New Zealand mud snail (*Potamopyrgus antipodarum*) in a stream that drains into Spirit Lake. Additionally, stomach samples from fish in Spirit Lake were also positive for the snail (see Charlie Crisafulli's Assessment of the Spatial Distribution of New Zealand Mud Snail in the Spirit Lake Basin, in the project file). The Forest will begin this spring to evaluate the extent of the presence and conduct an assessment of potential impacts to the Monument and its resources. Mitigation for this project have been included to reduce any further spread and the Monument will work with PNW and other researchers on next steps.

As with all projects and human/equipment entry into aquatic environments, there is a chance that additional New Zealand mud snails would be introduced and/or that the population recently detected could spread. Even decontamination protocols may not be 100% effective here or in other project/monitoring/recreation areas. The likelihood of introduction and spread from the proposed action is increased if decontamination protocols are not stringently followed.

Cumulative Effects

Potential cumulative effects to rainbow trout that are present in Spirit Lake and some of the streams draining into it could result from the implementation of the proposed action and other past, present, and future activities in this drainage. Specifically, there could be increased stream and lake turbidity and substrate siltation levels from the combination of (1) vehicular traffic associated with research being conducted in the project area and (2) this project's construction, maintenance activities, and usage/travel at the stream crossings and within certain stream reaches.

Alternative 1. West Access –JRO to South Shore Spirit Lake

Direct and Indirect Effects

As stated above in the effects section for the Proposed Action, there are no direct, indirect, or cumulative effects to any federally-listed fish species, Sensitive fish species, Management Indicator fish species, Critical Habitat, or Essential Fish Habitat because none of these are present in the project area. The only potential effects from Alternative 1 would be to rainbow trout, a non-listed resident fish species that is present in the project area.

Alternative 1 includes: (1) drilling of up to 25 bore holes for core sampling of debris avalanche, (2) water withdrawal from Spirit Lake and potentially some streams for 1-2 years for drilling activities, (3) the construction and UTV usage of a motorized route extending from Johnston Ridge to drilling locations for 1-2 years, (4) blasting on up to 10% of the proposed motorized route to ensure adequate width for administrative use/travel. This motorized route also includes the construction and usage of 2-4 stream crossings using culverts or other structures on the slopes from Johnston Ridge to the Pumice Plain and an additional 2 crossings. Further details can be found in the *Proposed Action and Alternatives* section of this EA.

The primary differences between this Alternative 1 and the Proposed Action are the locations of the proposed access routes, the potential use of culverts or similar structures at certain stream crossings, and the use of explosives on portions of the route under Alternative 1. While the potential amount of turbidity/sediment introduction will vary to a small to moderate degree between the Proposed Action and this alternative, it is expected to be of a small enough magnitude based on proximity to fish-bearing stream reaches and Spirit Lake that the potential effects to fish would be the same. Additionally, the use of explosives would occur in the upland and stream headwater areas where there are steep cross-slopes and no fish are present. Therefore, the direct and indirect effects to fish are expected to be similar for both the Proposed Action and Alternative 1.

Cumulative Effects

Potential cumulative effects to rainbow trout that are present in Spirit Lake and some of the streams draining into it from the implementation of Alternative 1 would be the same as those discussed above in the Proposed Action section.

Alternative 2. – East Access from FSR 99 Along Windy Ridge to Duck Bay

Direct and Indirect Effects

As stated above in the effects section for the Proposed Action, there are no direct, indirect, or cumulative effects to any federally-listed fish species, Sensitive fish species, Management Indicator fish species, Critical Habitat, or Essential Fish Habitat because none of these are present in the project area. The only potential effects from Alternative 2 would be to rainbow trout, a non-listed resident fish species that is present in the project area. Alternative 2 includes: (1) drilling of up to 25 bore holes for core sampling of debris avalanche, (2) water withdrawal from Spirit Lake and potentially some streams for 1-2 years for drilling activities. Also, for equipment access for core sample drilling, option 1 would be to fly in drilling equipment via helicopter and option 2 would be to construct a motorized access route from the terminus of FSR

99 across the Pumice Plain to the drilling locations via the existing old road bed (same access route described in the Proposed Action). Finally, for long-term access for maintenance of the Spirit Lake Tunnel and its associated infrastructure, option 1 would entail constructing a motorized access route from the terminus of FSR 99 along Windy Ridge/Forsythe Creek to Duck Bay, and option 2 would be to construct a motorized route from the terminus of FSR 99 across the Pumice Plain to Willow Springs and continue from Willow Springs to Spirit Lake (as described in the Proposed Action). Further details can be found in the *Proposed Action and Alternatives* section of this EA.

The primary differences between this Alternative 2 and the Proposed Action are the locations of the proposed access routes, the proposed motorized travel in Forsythe Creek, and the use of a helicopter to fly drilling equipment in and out of the project area. The use of a helicopter is not expected to affect fish or fish habitat. While the potential amount of turbidity and potential chemical introduction risk will vary to a moderate degree between the Proposed Action and this alternative, particularly in the stream reaches of Forsythe Creek where motorized travel is proposed, it is expected that the resultant effects to fish would be the same overall. Specifically, while more turbidity is expected in Forsythe Creek under Alternative 2 compared to the Proposed Action, the overall potential turbidity levels across the project area are expected to be less under this alternative. Therefore, based on proximity and magnitude, the direct and indirect effects to fish are expected to be similar for both the Proposed Action and Alternative 2.

Cumulative Effects

Potential cumulative effects to rainbow trout that are present in Spirit Lake and some of the streams draining into it from the implementation of Alternative 2 would be the same as those discussed above in the Proposed Action section.

Other Disclosures Required by Law, Policy, and Regulation

National Historic Preservation Act Compliance

A heritage resource report was prepared to complete agency requirements with respect to Section 106 of the National Historic Preservation Act and Title 36, Code of Federal Regulations, Chapter 800. The assessment of project effects considered direct effects to heritage resources within the Area of Potential Effects (APE). The proposed project, involving the development an access route to the south shored of Spirit Lake, in order to support maintenance of the tunnel inlet structure, log boom system and other constructed improvements that support safe elevation levels of Spirit Lake, will have no adverse effect to traditional cultural property values that contribute to National Register of Historic Places significance. The visual impacts to the Pumice Plain, as viewed from within the Traditional Cultural Property boundary, are expected to be minimal. This is primarily because the proposed route is along either a former road or a current administrative system trail. On this basis, there is a determination of "**Historic properties affected**" (36 CFR 800.4 (d)(2)), "**No adverse effect**" (36 CFR 800.5(b)) for the proposed project.

Effects on Environmental Justice
Executive Order 12898 (February 11, 1994) directs federal agencies to focus attention on the human health and environmental condition in minority and low-income communities. The purpose of the Executive Order is to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects on minority and low-income populations. The principle behind Environmental Justice is that people should not suffer disproportionately because of their ethnicity or income level.

The work activities associated with the proposed action would create short-term jobs; however the proposed action would not have a disproportionately high or adverse human health or environmental effect on minority and low-income populations.

Clean Water Act Compliance
All requirements associated with the Federal Clean Water Act and Washington State water quality regulations will be met through planning, application, monitoring and adjustment of Best Management Practices in conformance with the CWA and following guidance in USDA National Best Management Practices for Water Quality Management on National Forest System Lands (USDA 2012).

Wetlands and Floodplains
Executive Order 11988 is to avoid adverse impacts associated with the occupancy and modification of floodplains. Floodplains are defined by this order as, ". . . the lowland and relatively flat areas adjoining inland and coastal waters are including flood prone areas of offshore islands, including at a minimum, that area subject to a one percent [100-year recurrence] or greater chance of flooding in any one year." This project is in compliance with this direction.

Executive Order 11990 is to avoid adverse impacts associated with destruction or modification of wetlands. Wetlands are defined by this order as, ". . . areas inundated by surface or ground water with a frequency sufficient to support and under normal circumstances does or would support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, river overflows, mud flats, and natural ponds." This project is in compliance with this direction and will not adversely impact any wetlands.

Effects on Prime Farm Land, Range Land, Forest Land, and Wild and Scenic Rivers
There are no prime farm lands or prime range lands within the project footprint. Prime forest land is a term used only for non-public lands and does not apply to any land within the planning area. There are no designated, eligible or proposed Wild and Scenic Rivers or ecologically critical areas included in the project area.

Potential or Unusual Expenditures of Energy
There would be no potential or Unusual Expenditures of Energy with this project. The proposed action does not involve any forms of energy expenditure.

Conflicts with Plans, Policies, or other Jurisdictions
There would be no conflicts with plans, policies or other jurisdictions with the proposed action. All overlapping plans and policies have been evaluated for consistency. The Forest works with regulatory agencies in development of the proposal including the US Fish and Wildlife Service, the National Marine Fisheries Service, Washington State Department of Ecology and the State Historic Preservation Officer.

Consistency with the Gifford Pinchot Forest Plan and Mount St. Helens Comprehensive Management Plan
The proposed action was designed to be consistent with the Gifford Pinchot Forest Plan and stipulations from the Northwest Forest Plan. It is also consistent with the Mount St. Helens Comprehensive Management Plan.

Consumers, Civil Rights, Minority Groups, and Women
The activities in the proposed action do not appear to have a disproportionately high or adverse effect on consumers, minorities or women. The project would not have any effect on the civil rights of any human being.

Other Applicable State and Federal Laws
The activities associated with the proposed action are designed to be consistent with all other applicable state and federal laws. Applicable laws are listed in the Management Direction section and throughout the individual Forest Service specialist reports.

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